LEVELS AND COMPONENTS OF RESISTANCE TO LATE LEAFSPOT CAUSED BY *CERCOSPORIDIUM PERSONATUM* (BERK. & CURT.) DEIGHTON IN THE PEANUT (*ARACHIS HYPOGAEA* L.) GENOTYPES FLORUNNER, SOUTHERN RUNNER, AND UF 81206

By

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Gregory Robert Watson

This dissertation is dedicated to the first professionally trained plant pathologist that I ever knew, Dr. Kemper L. Callahan, my adviser during my undergraduate education at Greensboro College, Greensboro, NC Dr. Callahan provided a superior environment for the education of a biologist through his knowledge in areas as diverse as ornithology and cryptogamic botany, and his great love of the interaction between student and professor. "Doc C.," as he was called by biology majors, never made things easy because to survive in his courses you had to think; information was never spoon-fed. Laboratory classes involved putting on boots and field gear and hitting the woods, regardless of the weather. The most important thing to Dr. Callahan was that you reach as much of your potential as possible. He never would let you get by without your best effort.

Dr. Callahan died of cancer in August, 1983. The man will be forever a part of my memory and career.

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LEVELS AND COMPONENTS OF RESISTANCE TO LATE LEAFSPOT CAUSED BY *CERCOSPORIDIUM PERSONATUM* (BERK. & CURT.) DEIGHTON IN THE PEANUT (ARACHIS HYPOGAEA L.) GENOTYPES FLORUNNER, SOUTHERN RUNNER, AND UF 81206

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May 1987

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Late leafspot of peanut (Arachis hypogaea L.), caused by *Cercosporidium personatum* (Berk.& Curt.) Deighton, is a devastating foliar disease throughout the world. Two peanut genotypes, Southern Runner and UF 81206, were compared to Florunner, a popular commercial cultivar, to determine their levels of resistance to late leafspot. In field studies performed in 1984 and 1985, the amount of late leafspot severity (LLS), rate of late leafspot progress, and yield were compared for three genotypes under three application schedules of a protectant fungicide (chlorothalonil).

Greenhouse and field experiments were conducted to identify the components of resistance to late leafspot inherent in Southern Runner and UF 81206 by comparing these genotypes to Florunner. Lesion number, size, and coloration, time from inoculation to appearance of lesions and conidia (incubation and latent period, respectively), and amount of sporulation per leaf and lesion were evaluated. Fluorescent microscopy was utilized to observe late leafspot lesions on field-produced leaflets for potential differences in number and size of stromata.

The levels of LLS and the rate of progress of late leafspot were lower in unsprayed Southern Runner and UF 81206 than in the equivalent treatment in Florunner. Fungicide applications reduced the rate of late leafspot increase in all genotypes, but especially in Florunner. Yield in unsprayed Southern Runner and UF 81206 was greater than that in unsprayed Florunner. When the fungicide application interval was shortened from 19 days to 9 days, a significant yield increase occurred in Florunner, but not in Southern Runner. Fungicide applications did not increase yield of UF 81206.

Lesion size, latent period, and sporulation were reduced in Southern Runner and UF 81206 when compared to Florunner. In observations with fluorescent microscopy, conidiophore stromata of *C. personatum* on Southern Runner and UF 81206 were smaller than those on Florunner, which resulted in reduced areas of sporulation of *C. personatum* on Southern Runner and UF 81206.

Southern Runner and UF 81206 exhibited "slow-leafspotting" resistance through reduced late leafspot lesion size, sporulation, and lengthened latent periods. These genotypes have a yield potential competitive with Florunner.

CHAPTER I
LITERATURE REVIEW

[illegible] and pathogen description. The separation of the [illegible] [illegible]o. diseases of peanut (Arachis hypogaea L.) by Woodroof (112) in [illegible] signaled the beginning of the period when early and late leafspot [illegible]me widely recognized as major diseases. In this classic paper, Woodroof outlined the differences in the signs and symptoms associated with the pathogens and the diseases. The early leafspot pathogen still retains the designation used by Woodruff, that being Cercospora arachidicola Hori. The designation of the pathogen of late leafspot has gone through several name changes (66, 67, 78). The pathogen involved in the late leafspot of peanut is currently known as Cercosporidium personatum (Berk. & Curt.) Deighton. Major differences between the two pathogens are that C. personatum produces haustoria while C. arachidicola produces only intracellular and intercellular mycelium; conidiophores of C. personatum occur mainly on the abaxial leaf surface while with C. arachidicola they are mostly adaxial (112). The conidia also differ in size, measuring 18-60 x 5.4-10.8 um for C personatum and 37.8-108.0 x 2.7-5.4 um for C.arachidicola (112). Teleomorphic states of C. arachidicola and C. personatum were designated and described by Jenkins as Mycosphaerella arachidicola (now known as *Mycosphaerella arachidis* Deighton) (78) and *Mycosphaerella berkeleyi*, respectively (35, 36, 66, 67). The early leafspot pathogen was more easily cultured on synthetic media than the late leafspot pathogen. Success in culturing of *C. arachidicola* on synthetic media has been advanced by recent workers (49, 91, 98).

Jenkins stated that both diseases occurred on all above ground parts of the plant and that the pathogens penetrated through the stomata of both leaf surfaces as well as directly through the lateral faces of epidermal cells (21, 35). Jenkins also reported that early symptoms of the two leafspot diseases were indistinguishable but later in disease development they could be separated by the presence of a bright yellow halo (present in early stages of symptom development with early leafspot, absent in symptoms of late leafspot), the coloration of the lesions on the abaxial leaf surface (brown to tan for early leafspot and from dark brown to black for late leafspot), and the fact that sporulation of *C. personatum* was confined almost entirely to the lower leaf surface (35). The presence of a yellow halo around lesions to differentiate between early and late leafspot is a misleading characteristic because host genotype and environment affect the formation of a halo (79). Coloration of the lesion on the abaxial leaf surface has also been found to be an unreliable method of differentiation, particularly in peanut genotypes that show resistance to peanut leafspot (includes both early and late leafspots). The only reliable method to differentiate between the two peanut leafspot pathogens on different peanut genotypes is by examination of the fruiting structures and conidia after incubation of diseased leaves to induce sporulation (100). Identification of the pathogen is important to peanut growers because *C. personatus* induces defoliation at a more rapid rate than *C. arachidicola* (79). Differentiation of the pathogens is important in screening peanut genotypes because resistance to the two diseases is inherited independently (29, 64, 100).

Other workers (21, 40), have disagreed with Jenkins's(35) conclusions that direct penetration is the principal mode of entry of the early and late leafspot pathogens. Most penetrations occurred through stomata on the upper leaf surface (21, 40). In another study, when both leaf surfaces were sprayed with a conidial suspension of *C. personatus*, the abaxial leaf surface was found to retain more conidia but did not differ from the adaxial in the number of lesions formed (13). Conidia of *C. arachidicola* were found to germinate best when exposed to 200 and 100% relative humidity (72). Evaluation of conidial germination on the peanut leaf surface revealed that 95 to 99% of conidia germinated within 48 hr when subjected to favorable environmental conditions (1). Lower relative humidities significantly reduced conidial germination of this fungus, but secondary conidia were produced when conditions for conidial germination were suboptimal (72). Conditions of high relative humidity for periods greater than 24 hr favor the development of peanut leafspot (79).

Distribution. Peanut leafspot occurs wherever peanuts are grown commercially but the distribution of the two pathogens is varied (21). Hemingway (29) found that *C. personatus* was the more devastating pathogen when the two pathogens occur together. In Florida the predominant disease was demonstrated to be late leafspot (33) but the pronounced early leafspot, particularly early in the growing season, has been documented as well (25, 55, 59). In a study of peanut leafspot-susceptible genotypes in India, the age of plants had no effect on susceptibility, implicating other factors as determinants of the appearance of the two pathogens (79). Older leaves had more lesions of late leafspot than younger leaves on the same plant but this effect was confounded by differences in leaf size (15). In contrast, a decrease in the pod load, by the removal of flower buds, reduced peanut leafspot severity dramatically in two of three susceptible cultivars, indicating a relationship between the yield potential and susceptibility of a cultivar to peanut leafspot (62).

Aerobiology. The peak hours for conidial dispersion of the two fungi occurred between 10 a.m. and 3 p.m. (93, 97). Large numbers of *C. arachidicola* conidia were also found in the air at the onset of rainfall (93). A large difference in spore production between the two pathogens was measured in one study, with the mean aerial concentrations of conidia at the daily peak hour being 1,120 and 48 for *C. personatum* and *C. arachidicola*, respectively (97). Hemingway attributed a greater rate of increase in late leafspot incidence to the fact that larger percentages of lesion area are devoted to spore production than for lesions of early leafspot (29).

Epidemiology. Peanut leafspot disease progress has been monitored (59, 64, 70, 76, 77). The implementation of the logistic transformation (106) showed the rate of peanut leafspot progress in nonsprayed plots was extremely fast for a leafspotting fungus (77, 106). Monasterios (64) found comparisons of apparent infection rates (r) (106) inadequate to identify resistant genotypes whose differences in [illegible] were small. Pixley found the logistic transformation useful in the comparison of epidemics of peanut leafspot (76). Other transformations, such as the Gompertz (7, 62), have not been implemented in the study of peanut leafspot, nor has the spread of the disease been studied in detail.

Disease management. A major method of controlling peanut leafspot worldwide is the application of fungicides (44, 46, 61, 83, 95). Fungicides have been recommended for use in the southeastern United States for many years (113). The annual cost of managing foliar diseases of peanuts with fungicides in Georgia alone is estimated at $20 million (95). Many researchers have attempted to increase the benefit of applications and efficacy of fungicide through the use of prediction systems (5, 37, 38, 62, 75, 94). The prediction systems in use are based on the work of Jensen and Boyle (37) who showed that relative humidity and temperature affected the amount of peanut leafspot seen in the field. They developed a set of curves to show the conditions necessary for increase in infection by the peanut leafspot pathogens (37). This system was computerized (75) and shown to be a sound method for the efficient use of timing the application of fungicides in some locations in the southeastern United States (94). In fact, when net return to the grower who based his fungicide applications on a predictive advisory system was compared with return to the grower maintaining a fixed 14 day spray schedule, the former gained $192.55 to $220.57/ha from yield increases and decreased control costs (38). The application of fungicides according to such extremely frequent occurrence of environmental conditions conducive to peanut leafspot.

Although fungicides are expensive, they have significantly increased yields of peanut seed (25, 61) and yield and quality of forage (14). Fungicides used in peanut production were at first formulated as dusts which are efficacious but less so than formulations currently available (61, 113). Fungicides vary in their efficacy, but it has been shown that the level of disease pressure dictates which fungicides are appropriate for adequate disease control (44, 45).

Studies involving the effect of fungicides on early or late leafspot have concentrated on assessments of disease late in the growing season, with less data available on the effect of fungicides on the progress of epidemics of peanut leafspot throughout the growing season. In general, the application of fungicides is thought to slow the rate of disease progress (6, 20). In one study, Plaut and Berger (77) found that the primary effect of the fungicide applications was in the reduction of initial disease (77). However, Smith and Crosby (92) reported that the rate of defoliation was decreased by the application of a fungicide to control peanut leafspot.

One fungicide registered for control of peanut leafspot has fallen into disuse because of the prevalence of a tolerant populations of both peanut leafspot pathogens (12, 50). This fungicide, benomyl (available as Benlate, DuPont, Wilmington, Del.), is still used in combination with other fungicides in some areas (38, 44). The rapid appearance of tolerance to this fungicide indicates that there is such diversity within the populations of the *C. arachidicola* and *C.*

Other techniques are important for the management of peanut leafspot; for instance, crop rotation has been shown to reduce the amount of peanut leafspot in commercial fields (43). Early planting is another important management tool (103). Research has also been done on the control of late leafspot with the mycoparasite *Hansfordia pulvinata* (63).

Physiology. The effects of peanut leafspot on physiological processes of the plant have been investigated to a small degree. The photosynthetic capacity of leaves with symptoms of peanut leafspot is greatly reduced (97). Sweny (104) found increased respiration in healthy plant tissues surrounding lesions of *C. personatum* in two varieties that varied in susceptibility. The less susceptible variety achieved higher respiration rates faster than the more susceptible variety. This more rapid increase in respiration was accompanied by early yellowing and abscission of the leaves of the less susceptible variety, leading the author to conclude that the abscission resulted in a "self-roguing process" which would result in lower amounts of disease incidence (104). Evidence for the production of cellulolytic and pectolytic enzymes (3) in *C. arachidicola* agrees with the fact that this pathogen kills host tissue in advance of mycelial colonization (1, 21).

Both *C. arachidicola* and *C. personatum* have been shown to produce the photosensitizing toxin cercosporin (2, 106) *in vitro* and in the leaves of diseased plants. Cercosporin has been found in other species of *Cercospora* and is a nonspecific toxin that affects cells of [illegible] plants only when they are exposed to [illegible]. Isolates of *C. arachidicola* and *C. personatum* that do not produce cercosporin are still pathogenic to peanuts (2). However, this does not rule out the possibility that cercosporin is involved in the pathogenesis of *C. arachidicola* and *C. personatum*.

Defoliation. Measurements of the loss in photosynthetic area due to peanut leafspot have been made in the past. Melouk (57) reported a significant positive correlation between the early leafspot severity on a leaf and the amount of chlorophyll loss. This relationship shows that peanut leafspot limits photosynthetic area by the loss of chlorophyll as well as enhancing leaf senescence (13).

Defoliation of peanut plants attributed to peanut leafspot has been significantly and negatively correlated to seed and forage yield (14). Peanut leafspot reduces the leaf area index (LAI) of peanut crops (10, 16, 76, 105). Elston et al. (16) measured the LAI of a peanut crop through the growing season and reported a decrease in LAI 96 to 110 days after planting (DAP) regardless of the peanut leafspot severity. In another study, when peanut leafspot was controlled to allow "optimum" growth, a maximum LAI of 7.1 was measured at 87 DAP after which LAI decreased to 1.7 at 138 DAP, the date of harvest (56). Other researchers have demonstrated that protection of the peanut plant with applications of fungicides results in the elimination of this drop in LAI (76, 105). Computer simulation of LAI values for the peanut cultivar Florunner throughout the growing season in "no disease" and "+ *Cercospora*" environments included this difference in rates of decline (9). It should be noted that the "+ Cercospora" simulation was modeled after epidemics of peanut leafspot in previous experiments (16).

Leafspot diseases limit canopy photosynthesis in peanuts by reducing the LAI (11). Photosynthetic rates of single leaves were reduced in proportion to the peanut leafspot severity on the leaves, according to Chakel and Sandhu (11) and Boote et al. (10). The canopy region in which defoliation occurred was important because the majority of the light interception by the canopy occurred in the top portion (10). Further, leaves in the top canopy portion were more photosynthetically active than those in lower canopy regions (10, 30). Henning et al. (30) reported a decrease in photosynthetic rate regardless of leaf position during the period of pod fill.

Artificial defoliation imposed at the beginning of the pod fill period affected final yield more than than similar treatments imposed earlier or later in the season (10). Artificial defoliation during the vegetative stage of growth was partially compensated for by leaf replacement. Increases in LAI in defoliated canopies were of similar magnitude to those observed in non-defoliated canopies, indicating that no stimulation of leaf growth had occurred as a result of defoliation. Leaves remained on artificially defoliated plants for longer periods of time, but increased leaf retention did not result in light interception area equal to that in non-defoliated plants (39). The relationship of artificial defoliation treatments to defoliation caused by peanut leafspot is not clearly defined, but fruit growth rate of artificially defoliated peanuts was greater than that of peanuts infected with the peanut leafspot pathogens (10).

Peanut leafspot affects root mass and nodulation, and lowers the yield potential of peanuts by reducing the number of pegs in susceptible cultivars (58). Inoculation of one month old plants with C. arachidicola resulted in leaflet defoliation of 30% or more and two months later, dry root mass was found to be reduced from 37 to 52%, depending on the cultivar. Numbers of pegs formed on the inoculated plants were 51 to 93% less than on uninoculated controls and root nodulation was also significantly decreased by 23 to 46% (58).

Resistance to early and late leafspot. Resistance to both early and late leafspots of peanut has been described and there is great interest in breeding for increased peanut leafspot resistance (25, 41, 60, 101). Chahal and Sandhu tested 58 varieties of peanut for peanut leafspot resistance by field inoculations and reported that bunch plant types were more susceptible than spreading and semi-spreading types with the exception of Tifton 1108 (11). When Tifton 1108 and several plant introductions were tested, increased levels of early leafspot resistance were noted in several plant introductions, especially PI 109839 (96). Hassan and Beute (28) suggested the use of NC 3033, NC 5, and AC 3139 for use in a breeding program to incorporate resistance to early leafspot. Further evaluation of the above-mentioned lines along with other plant introductions and Arachis species led to the conclusion that the levels of resistance in PI 109839, PI 270806, and NC 3033 were acceptable as germplasm sources for resistance to early leafspot (20). However, PI 270806 and NC 3033 were susceptible to early leafspot in experiments performed in Malawi (103).

Many of the peanut leafspot resistant plant lines are low yielding and late maturing (22, 96). The incorporation of peanut leafspot resistance and desirable agronomic and quality traits into a single plant genotype is possible (27). Pixley (76) demonstrated that two genotypes of *A. hypogaea* that reduce the rate of peanut leafspot progress, UF 80202 and UF 81206, were also capable of achieving high yields. A later maturity was found for these late leafspot resistant genotypes, a trend seen in other plant species showing rate-reducing resistance (51).

Some *Arachis* species other than *A. hypogaea* have resistance to the peanut leafspots. High levels of resistance to early and late leafspot were found in *A. chacoense* and *A. cardenasii*, respectively. Both species are cross-compatible with *A. hypogaea* (1). Progeny of *A. cardenasii* x *A. hypogaea* and of *A. chacoense* x *A. hypogaea* retained the resistance, leading to the conclusion that the transfer of genes from these species into *A. hypogaea* should increase the resistance to both peanut leafspot pathogens (87). High degrees of resistance to late leafspot were identified within 96 accessions of wild *Arachis* species, some accessions and lesions with no sporulation (102).

Six Virginia-type lines were studied by Sermsey et al. (41), two of which were resistant to early and late leafspot and four of which were resistant to only one disease. Resistance to each disease was primarily due to additive genetic effects, and where resistance to both occurred, the resistances were inherited independently (41). Mecassories (64) evaluated a large number of peanut lines and concluded that the same genes conditioning resistance to early leafspot may condition susceptibility to late leafspot and vice versa

(64). Other workers (1, 4) have concluded that inheritance of resistance to early leafspot is independent of resistance to late leafspot Workers using peanut lines selected for resistance to early leafspot demonstrated levels of resistance to late leafspot within these selections (110).

Methods used in the assessment of resistance to peanut leafspots are almost as numerous as the researchers who have performed the work. Hemeterios (64) stated that subjective visible assessments of peanut leafspot severity were not acceptable and concluded that lesion counts were the best method to separate susceptible and resistant lines. His conclusion was biased because he did not attempt to separate the early and late leafspot in his visual disease assessments, but did in his lesion counts. Melouk et al. (60) have used severity and defoliation assessments along with a relative rating scale for the amount of sporulation present on a lesion. Foster et al. (18) concluded that the number of lesions per leaf and percent defoliation were the most useful methods to screen lines for disease resistance. Finally, screening for peanut leafspot resistance has involved evaluations of the number of lesions, the amount of defoliation, and the severity of the disease.

Evaluations of resistance have been done using plants grown in the field and greenhouse, or detached leaves from field plants (102). Plants grown continually in the greenhouse were found to have higher numbers of lesions than plants grown in pots outside the greenhouse when inoculated with the same conidial concentration of C. arachidicola (28). In fact, NC 3033 had more lesions than a number of lines in the greenhouse but consistently had reduced lesion numbers in the field (28). Later experiments confirmed this effect of environment on variations in lesion number (81). This phenomenon has been demonstrated for other pathosystems in which the host genotype exhibited horizontal resistance (106) by a mechanism involving reductions in lesion number (54).

In many experiments the components of resistance (73, 114) inherent in peanut leafspot germplasm have been of interest. Significant differences in lesion numbers on plants inoculated with *C. arachidicola* and *C. personatum* were found by several researchers (1, 64, 87, 96, 102). Conversely, non-significant differences in lesion number on peanut genotypes varying in resistance were reported in other studies (70, 71, 110). In some cases when differences in the number of lesions formed have been found, the penetration of the pathogens into peanut leaves has been investigated. Initial reports concluded that stomatal size influenced resistance to peanut leafspot (22), but other workers (13, 28) disagreed with this conclusion. Differences in stomatal density among peanut lines did not relate to the observed resistance to late leafspot (13). Conidia of both *C. arachidicola* and *C. personatum* would not penetrate into the leaves of *Arachis* species classified as being "immune" (1). Nevill (71) reported that the number of lesions on leaves of all lines under study was proportional to inoculum density, regardless of resistance.

Measurements of lesion size on peanut lines differing in their resistance to peanut leafspot have shown varying results. Lesions caused by *C. arachidicola* were not significantly different in size on different genotypes in some studies (81) but differences in size of lesions of early and late leafspot (17, 64) and of late leafspot (102,

79) were found in other studies. Reductions in lesion size and lesion number were correlated so that selection in a breeding program for one of these characters would advance the other (64). In microscopic investigations of peanut leaf sections after inoculation with *C. arachidicola* and *C. personatum*, revealed fungal growth was found to be restricted in "moderately susceptible" and "highly resistant" plant groupings but no measurements of lesion size were performed (1).

Other components of resistance besides reduction in the lesion number and size are of interest. Latent period is an important epidemiological parameter (107). Differences in the latent period (the time from inoculation until sporulation) on different lines were demonstrated by Nevill (71) for both early and late leafspot. Resistant lines had longer latent periods. Latent periods were found to be longer on resistant lines in other studies as well (17, 81, 110). Values for the latent period of early leafspot ranged from 18.4 to 22.6 (71) and 17.8 to 24.4 days (81). Latent periods for late leafspot have ranged from 11.7 to 23.9 (71) and 22 to 24 days (110). Walls et al. (110) and Ricker et al. (81) reported higher values because they measured the time from inoculation until 50% of the lesions were sporulating (LP_{50}), while Nevill (71) measured the time until initial sporulation (LP_0).

Nevill (71) reported reduced sporulation of *C. arachidicola* and *C. personatum* on resistant peanut genotypes. Sporulation per lesion per day on four genotypes ranged from 17 to 100 and 4.3 to 580 for *C. arachidicola* and *C. personatum* lesions, respectively. Number of conidia of *C. arachidicola* per leaflet and per mm^2 of lesion was significantly lower on resistant peanut lines (17, 23). Sporulation indices which estimate the amount of sporulation on individual lesions have been used to differentiate early (60) and late leafspot (102, 110) resistant genotypes. Stromal formation of both peanut leafspot pathogens was greatly restricted in genotypes classified as moderately susceptible and highly resistant (2).

In experiments where a number of components of resistance (components analysis experiments) (114) have been studied (lesion number, incubation period, latent period, and amount of sporulation), no line was found to affect all stages of the disease monocycle (114). Nevill (71) reported delayed defoliation and reduced pathogen development in EC 76446(292) and PI 259747 but no reduction in the percentage of spores that eventually caused lesions. Walls et al. (114) found significant correlations among many components of resistance to late leafspot, the resistant lines had smaller lesions, longer latent periods and reduced sporulation. This and other evidence (60, 102) indicates a tendency for several components of resistance to be present in resistant peanut genotypes, a trend which has been demonstrated in other pathosystems where resistance was found to delay epidemics (73).

CHAPTER II
FIELD STUDIES

Introduction

Late leafspot of peanut, caused by Cercosporidium personatum (Berk. & Curt.) Deighton, is a major foliar disease of peanuts (Arachis hypogaea L.) throughout the world (95), and recently predominates over Cercospora arachidicola Hori in importance in Florida (33). Plant breeding programs throughout the world have been concerned with identifying agronomically acceptable peanut genotypes with resistance to both early and late leafspot (25, 41, 101). The University of Florida has been the first to release such a variety, Southern Runner (24), and another genotype of this type, UF 81206, has been considered for release. Southern Runner and UF 81206 have greater levels of late leafspot resistance than Florunner (76), the most widely grown peanut cultivar in the southeastern United States (95). Further quantification of the levels of resistance in Southern Runner and UF 81206 is needed.

Since van der Plank (106) introduced the terms horizontal and vertical resistance, several authors have added to his interpretation (68, 73, 82). Nelson (68) has stated that horizontal resistance should be referred to as rate-reducing resistance, that is, resistance that has its major effect on the rate of progress of the epidemic. Shaner and co-workers (47, 84) and Luke and Berger (53) have utilized the terms slow-mildewing and slow-rusting to identify the same rate-reducing phenomenon. Currently, one cannot test to see if the resistance is differential (19) as there are no known races of either *C. arachidicola* or *C. personatum* although variations in the reaction of peanut genotypes to *C. personatum* has been described (100).

In this investigation the effects of late leafspot resistance and various fungicide schedules on peanut leafspot epidemics occurring in the field were studied. Research centered around assessing peanut leafspot severities at individual dates and on the progress of leafspot epidemics throughout the growing season. Individual leaves of each genotype within different fungicide schedules were also studied to determine whether leafspot resistance or fungicide applications manifested themselves by increasing the time the average individual leaf remained on the plant. Leaf area and reproductive biomass accumulation were also of interest. By studying disease progress and leaf area accumulation in the field under currently recommended fungicide schedules, information for proper spray scheduling could be developed for growers who plant Southern Runner and UF 81206. Southern Runner and UF 81206 were previously shown to retard the progress of leafspot epidemics (74), but the epidemics were studied under fungicide schedules different from those currently recommended to Florida peanut growers.

Research was also performed to place Southern Runner and UF 81206 under two distinct levels of late leafspot inoculum. One of the goals of this experiment was to expose the genotypes to levels of late leafspot inoculum that would exceed that found in a commercial grower's situation. The effects of the different levels of inoculum on these late leafspot resistant genotypes were investigated at individual assessment dates. Rates of leafspot progress throughout the growing season were also investigated and comparisons between the progress rates under the two levels of inoculum were performed.

In summary, the objective of this research was to identify levels of resistance in Southern Runner and UF 81206 and the effect of this resistance and fungicide schedules on leafspot epidemics in the field.

Materials and Methods

Polycyclic Epidemic Processes Experiment (PEPE)

This experiment was performed in 1984 on plot land at the Marianna Airport and in 1985 at the Dozier Boys' School in Marianna, FL. Since materials, methods, and results from the experiments were extremely similar, only the materials, methods, and results from the 1985 experiment are presented.

Genotypes and fungicide schedules. A split-plot, randomized complete block design with four replications was utilized in a factorial experiment comparing three genotypes and three fungicide schedules. Southern Runner, UF 81206, and Florunner were assigned at random to the subplots whereas the fungicide schedules were assigned at random to the main plots. Southern Runner was a selection from a cross between PI 203396 and Florunner and UF 81206 is the progeny of a cross between PI 203396 and F4278-3-1-7-4. Subplots were 12 rows wide planted on 0.91 m centers and were 6.1 m long. Unplanted borders, 3.05 m long, separated the 32.9 m x 6.1 m main plots. Fungicide schedules consisted of an nonsprayed control, a 19-day and a 9-day interval (20- and 10-day spray schedules, respectively) between applications of 2.48 L/ha of chlorothalonil (Bravo 500, Fermenta Plant Protection Company, Cleveland, OH) in 94.6 L/ha of water. This is the highest labelled rate currently recommended for the control of peanut leafspot (44). A total of 5 and 10 applications were made per season in the 20-day and 10-day spray schedules, respectively. Fungicide schedules were initiated 43 days after planting (DAP). A backpack sprayer (Weed Systems Inc., Gainesville, FL) using three D2-25 nozzles per row and 3.5 kg/cm^2 with CO$_2$ as a propellant was employed on the first seven application dates. The remainder of the fungicide applications were made using a tractor mounted spray system (BC) with the same specifications as the backpack sprayer, except spray was applied at 2.1 kg/cm^2 of pressure. Common agronomic practices involved in peanut production were followed throughout the experiment.

Disease assessment and analysis. Severities of early and late leafspot were assessed using a plexiglass (3M Corp, Minneapolis, MN) form fashioned to differentiate canopy layers as described by Plaut and Berger (77). The amount of chlorosis and necrosis attributable to each disease was estimated in three distinct canopy layers utilizing standard area diagrams depicting various severities of peanut leafspot. The severity of early leafspot throughout the experimental period was low, and when included in statistical analysis it was summed with the severity of late leafspot occurring within the same plot. Disease assessments were made 34, 42, 55, 65, 76, 86, 97, 107, 121, and 135 DAP.

Late leafspot severity and the sum of early and late leafspot severities in each canopy region were subjected to analysis of variance. As the season progressed, the bottom and then the middle canopy regions had to be deleted from statistical analyses because of the complete defoliation of these regions in some treatment combinations.

Differences in disease progress among genotypes in nonsprayed plots and among fungicide schedules within each genotype were tested by regressing late leafspot severity (LLS) against DAP. Nontransformed LLS data were used in regressions as were LLS data transformed by the Gompertz and logistic transformations (7, 53). Statistical methods to test significance of differences between regression lines and regression parameters were employed to discern differences in the progress of late leafspot between genotypes and fungicide schedules [general linear test approach, comparison of regression parameters, (69)]. Computer programs written in basic for the IBM XT (IBM, Boca Raton, FL) were utilized to test regression lines and regression parameters. Any zeros that appeared in the data were not included in the regression analyses.

Defoliation. Defoliation was measured by counting the number of nodes with four leaflets abscised and the total number of nodes on mainstems of eight plants in each subplot on each assessment date. Total nodes were recorded to assess relative growth of the genotypes. Overall defoliation, i.e., defoliation regardless of canopy layer, was calculated by taking the ratio of the number of nodes with four leaflets abscised to the total number of nodes and expressing it as a percentage (41). Defoliation in each of the three canopy regions was [illegible] by counting the number of nodes in each canopy region of each of the three genotypes. It was found that the same number of nodes formed for each genotype regardless of the fungicide schedule. Respectively for Florunner, Southern Runner, and UF 81206, the mean number of nodes was 5, 5, and 15; 5, 5, and 17; and 6, 5, and 17 for the bottom, middle, and top canopy regions. The ratio of nodes with four leaflets abscised to the mean number of nodes in each canopy region (expressed as a percentage) was the defoliation rating for each canopy region at each assessment date. All defoliation data on each assessment date were subjected to analysis of variance.

On individual disease assessment dates, correlations between defoliation and the LLS in each canopy region were made (65). Where significant positive correlations between LLS and defoliation existed, linear regressions of defoliation on LLS were performed to test differences between genotypes (69). Each regression contained data for individual genotypes over all three fungicide schedules.

Leaf area index (LAI) and reproductive biomass accumulation. All peanut plants from 0.91 m of either row 2 or 4 (0.836 m^2) in the subplots were harvested at each sampling date. Samples were dug 43, 57, 70, 87, 100, and 131 DAP with a potato pitchfork in order to minimize pod loss. Samples were removed from the field in burlap bags and washed. A typical plant was selected from the 0.836 m^2 sample and the leaves were assigned to one of the canopy layers using the plexiglass form used in disease assessments. Leaves from each canopy region were passed through a portable leaf area meter (Li-Cor, Inc., Lincoln, NE) and the total leaf area for each canopy region was recorded (LAB, LAM, LAT = leaf area bottom, middle, and top canopy regions, respectively). Leaf areas for the three canopy regions were then summed to calculate a total leaf area per plant (TLAp). Leaves, stems, and pods from the selected plant were placed in separate paper bags and, along with the entire 0.836 m^2 sample, dried in a drying oven (temperature held at 37.8C) for a minimum of 72 hrs. The bags were then removed from the drying oven and weighed (LWTp, SWTp, PWTp, and TWTp, - dry weight of leaf, stem , pod, and total respectively for the selected plant; TWTs = total weight of the 0.836 m^2 sample). Leaf area for the entire 0.836 m^2 sample (TLAs) was calculated by the following equation:

$$TLAs = (TLAp/TWTp) * TWTs. \quad \text{(equation 1)}$$

The leaf area index for the entire 0.836 m^2 sample (LAIs) (76) was calculated by dividing the TLAs by 8361.3 cm^2 while the leaf areas for each canopy layer were calculated as the product of TLAs and the ratios LABp/TLAp, LAMp/TLAp, and LATp/TLAp for the leaf area of the 0.836 m^2 (8361.3 cm^2) in the bottom (TLABs), middle (TLAMs), and top (TLATs) canopy regions, respectively. Further, leaf area index values for each canopy region of the 0.836 m^2 were calculated by the following equations:

$$\text{leaf area index-bottom (LAIB)} = (TLAs * (LABp/TLAp))/8361.3$$
$$\text{(equation 2)}$$

$$\text{leaf area index-middle (LAIM)} = (TLAs * (LAMp/TLAp))/8361.3$$
$$\text{(equation 3)}$$

leaf area index-top (LAIt = (TLAs * (LATp/TLAp))/836.3

(equation 4)

Comparisons of leaf area over the entire canopy and within each canopy region for each genotype and fungicide schedule were done utilizing analysis of variance at each assessment date. There was no attempt to perform linear regressions for leaf area accumulation data against time or to fit the data to a distribution for the time intervals investigated. Correlations between defoliation ratings and leaf area accumulation data were performed to test the accuracy of the method of assessing defoliation used in this experiment. Correlations between LLS and LAI in each canopy region were computed to test for a significant effect of LLS on LAI. Correlations were computed for disease assessment dates paired with leaf area assessment dates in the following manner: 57 and 55, 70 and 65, 87 and 86, 100 and 97, and 131 and 135 DAP.

Reproductive biomass accumulation was studied utilizing the same 0.836 m^2 sample taken for study of leaf area accumulation. Reproductive tissue included the pods, with harvesting of these tissues beginning when the first thickening of the peg terminus was observed (8). Pod weight of the 0.836 m^2 sample (PWTs) was calculated by multiplying the TWTs by the ratio of pod weight to total plant weight of the single plant sample (PWTp/TWTp). The ratio of PWTs to TWTs was also calculated (note it is equal to PWTp/TWTp) and was called the harvest index (HI). This ratio gives an indication of the state of the "source-sink" relationship, that is, a high harvest index indicates that the photosynthesizing portions of the plant are [illegible] photosynthate for the seed. By knowing the size of the [illegible] from leaf area accumulation data and the harvest index, the relative importance of these variables in determining yield can be distinguished.

The amount of reproductive tissue (pod weight) and the harvest index values were subjected to analysis of variance to test the effects of genotype and fungicide schedule.

Diseased leaf area (DLA). The amount of diseased leaf area (DLA) within each canopy region of each treatment combination was calculated as the product of the canopy region leaf area and the late leafspot severity expressed as a proportion. Since leaf area and disease severity assessments occurred on different days, DLA was calculated using the assessments made on 57 and 55, 70 and 65, 87 and 86, 100 and 97, and 131 and 135 DAP for leaf area and disease severity, respectively. Regressions of DLA, log DLA, and (-ln(-ln(DLA/10000))) against DAP were performed and the resulting regression parameters subjected to statistical procedures to test for differences among genotypes in nonsprayed plots (general linear test approach, comparisons of regression parameters) (69). The transformation (-ln(-ln(DLA/10000))) was selected after test plots showed that this manipulation was effective in linearizing the data. Zeros in the data were disregarded in the regression analyses. DLA at each combination of assessment dates was subjected to analysis of variance.

Individual leaf assessment. In the center of row 7 of the twelve row subplots a single plant was marked with a flag at 34 DAP. On each disease assessment date, bell wire of a different color was used to mark the most recent fully emerged leaf on three stems of the flagged plant. Selected stems were at the same position on each plant, a center-main stem was chosen for tagging, as were two side stems, one on each side of the center main stem (76). The time from tagging until leaf abscission was recorded and disease severity on the leaf was assessed when LLS assessments were made. The mean number of days that leaves were on the plant was calculated by taking the average of the leaves' longevity on each of the three stems. The maximum number of days a given leaf could remain on the plant was calculated by subtracting the number of days after planting on which the leaf was tagged from 139 (the DAP at harvest). The time a leaf remained on the plant was expressed as a percentage of this maximum.

The percentage of total possible days on the plant and the maximum peanut leafspot severity assessed on the leaf before abscission were subjected to analysis of variance.

Yield. Yield data were collected at three harvest dates at 125, 139, and 160 DAP. Rows 8 and 9, 6 and 7, and 10 and 11 in each subplot were dug on the first, second, and third harvest dates, respectively. Using the pod profile method (111) on pods from the 19-day interval fungicide schedule, the optimum harvest date was determined for each genotype. Pods were threshed after three days of drying in the field, dried for 24 hrs with forced air and weighed. On the first two harvest dates a 0.836 m^2 wooden frame was placed over one of the two harvested rows after digging. All the pods that could be found within the outline of the wooden frame were bagged, dried in the greenhouse, and weighed.

Analysis of variance. Analysis of variance was performed using MSTAT, Version 3.0 (Michigan State University, Lansing, MI) on IBM PC and IBM XT microcomputers. The split-plot analysis of [illegible] procedure from Steel and Torrie (99) was used and the pre[illegible] of a genotype x replicate interaction was ignored. Selected data sets were analyzed utilizing SAS (SAS Institute, Cary, NC) including the genotype x replicate interaction and testing its significance with the residual error term. The genotype x replicate interaction was never found to be significant, making the pooling of the genotype x replicate interaction and the residual error term legitimate (65).

When significant genotype x fungicide schedule interactions were found, Satterthwaite's procedure (65) was utilized to calculate the error degrees of freedom for testing significance in preplanned orthogonal contrasts. Contrasts were performed when of interest and were conducted in the following manner: when significant fungicide schedule x genotype interactions occurred, nonsprayed versus 10-day, and nonsprayed versus 20-day schedule means were contrasted for Florunner, while only nonsprayed versus 10-day schedule means were contrasted for Southern Runner and UF 81206. Differences among means of treatments giving a significant F ratio in analysis of variance were tested using Newman-Keuls mean separation procedure, either at the 0.05 or the 0.01 level of significance (65).

Interaction Test (IT)

This experiment was performed in 1985 at the Dozier Boys' School in Marianna, FL.

Experimental design. A randomized complete block experimental design with four replications was used to compare Southern Runner and UF 81206 at two levels of inoculum. The approach for creating two levels of inoculum was modeled after Kucharek et al. (45) and used the phenomenon of alloinfection or interplot interference (cryptic error) 106, 114). Four rows (55.8 m^2) of Southern Runner or UF 81206 were bordered on two sides by twelve rows (83.6 m^2) of sprayed or nonsprayed Florunner. Sprayed rows of Florunner received applications of chlorothalonil at 1.5x the highest labeled rate (3.72 L/ha) early in the season and later in the growing season received 2x the highest labeled rate (5 L/ha) (44). Fungicide applications were made using a tractor mounted sprayer (80) with a 14-day interval between applications. Plots of Southern Runner and UF 81206 were never treated with a fungicide to control peanut leafspot. Even though late leafspot was found in this plot area at 43 DAP, pots containing plants of Early Bunch, a cultivar highly susceptible to late leafspot, were placed in the center of the nonsprayed rows of Florunner at 44 and 58 DAP. These plants were grown, inoculated with C. personatum, and incubated under greenhouse conditions before placement in the plot area.

Disease and defoliation assessment. Disease severity and defoliation were assessed as described above for the PEFE with assessments at 43, 58, 71, 79, 86, 100, 114, 123, and 136 DAP. Assessments were made in a 3.05 m long staked area in the center two rows of the Southern Runner and UF 81206 plots. Late leafspot severity, early leafspot severity, and defoliation in each canopy region, and overall defoliation were subjected to analysis of variance for each individual assessment date. Certain canopy regions were not considered on some assessment dates because of total defoliation of these regions in some treatment combinations.

Progress of the late leafspot epidemics in Southern Runner and UF 81206 for the two levels of inoculum were compared as described in PEPE, except that the sum of early and late leafspot within each canopy region was utilized instead of LLS. This was done because of significant effects of genotype and inoculum level on early leafspot severity at individual assessment dates. Correlations between late leafspot severity and defoliation were also investigated in the manner described in PEPE.

Yield. The center two rows of the Southern Runner and UF 81206 plots were dug 140 DAP, threshed, bagged, dried with forced air for 24 hrs in a wagon, and weighed.

Analysis of variance. Analysis of variance was performed utilizing MSTAT, Version 3.0 on IBM PC and IBM XT microcomputers. The analysis of variance procedure is that described for a randomized complete block design in Steel and Torrie (99). Mean separations and other statistical procedures were those described in PEPE.

Results

Polycyclic Epidemic Processes Experiment (PEPE) 1985

Disease assessment. No significant effects of either fungicide schedule or genotype on severity of early leafspot in any canopy region were found. Early leafspot severity did not exceed 1% on any rating date.

Progress of late leafspot in nonsprayed plots of Florunner, Southern Runner, and UF 81206 in each canopy region is illustrated in Figures 1 through 3. Termination points of the lines for individual genotypes in a particular canopy region differ because total defoliation of particular canopy regions occurred at different times for the three genotypes. For instance, the bottom canopy of Florunner was totally defoliated by the 97 DAP assessment date, but the bottom canopy in Southern Runner was not totally defoliated until 107 DAP. Levels of late leafspot in Florunner in each canopy region were higher than those in either Southern Runner or UF 81206.

Regressions of LLS against time in nonsprayed plots of Florunner, Southern Runner, and UF 81206 showed significant differences among these genotypes in the rate of late leafspot progress (Table 1). Slopes of disease progress curves for Florunner were significantly higher than for Southern Runner and UF 81206 in the bottom and middle canopy regions. In the top canopy region late leafspot progressed significantly faster in Florunner than in Southern Runner and UF 81206 using nontransformed LLS and data transformed using the Gompertz transformation. Significant differences in the slopes of late leafspot progress curves among all genotypes were found only in the nontransformed LLS data for the top and middle canopy regions.

All regressions of LLS against time were significant, regardless of the form of LLS used (nontransformed, logistic or Gompertz transformed), but the coefficient of determination (r^2) shows that the logistic and Gompertz transformations often improved the fit (Table 1).

With analysis of variance of LLS on individual assessment dates, highly significant effects of fungicide schedule and genotype on LLS

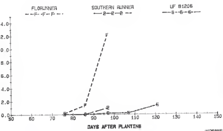

Figure 1. The progress of late leafspot in the bottom canopy on Florunner, Southern Runner, and UF 81206 receiving no fungicide to control late leafspot.

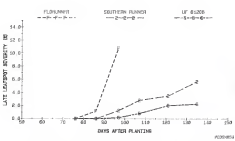

Figure 2. The progress of late leafspot in the middle canopy on Florunner, Southern Runner, and UF 81206 receiving no fungicide to control late leafspot.

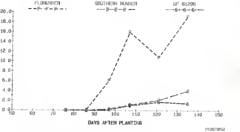

Figure 3. The progress of late leafspot in the top canopy on Florunner, Southern Runner, and UF 81206 receiving no fungicide to control late leafspot.

Table 1. Comparisons of late leafspot epidemics in nonsprayed treatments of each of three peanut genotypes using linear regressions of late leafspot severity on time. Regressions were performed for nontransformed data and data transformed by means of the logistic and Gompertz transformations.

Canopy region and genotype	Regression statistics								
	Nontransformed			Logistic transformation			Gompertz transformation		
	Y_o^x	Slope^x	r^{2x}	Y_o	Slope	r^2	Y_o	Slope	r^2
Bottom									
Florunner	-15.9^y	0.25a	0.586	-26.2	0.25a	0.946	-4.96	0.042a	0.949
Southern Runner	-1.5	0.02b	0.326	-26.1	0.21ab	0.865	-4.13	0.025b	0.816
UF 81206	-0.8	0.01b	0.422	-22.1	0.15b	0.735	-3.63	0.017b	0.737
Middle									
Florunner	-22.7	0.32a	0.666	-32.4	0.32a	0.947	-6.08	0.054a	0.941
Southern Runner	-4.7	0.07b	0.756	-22.2	0.16b	0.887	-3.97	0.023b	0.898
UF 81206	-2.5	0.03c	0.723	-22.9	0.15b	0.854	-3.91	0.020b	0.861
Top									
Florunner	-20.8	0.29a	0.766	-22.3	0.17a	0.796	-4.52	0.032a	0.838
Southern Runner	-5.2	0.06b	0.770	-24.3	0.17a	0.853	-4.29	0.024b	0.899
UF 81206	-2.4	0.03c	0.571	-24.9	0.17a	0.794	-4.14	0.021b	0.80

x - Y_o, slope, and r^2 are the estimated y-intercept, slope, and coefficient of determination of the regression line.

y - Regression slopes within each genotype/transformation group denoted by the same letter are not significantly different at the P = 0.05 level.

were found. However, at and after 86 DAP, whenever [illegible] both of these main effects in the statistical model were significant for a given canopy region, a significant fungicide schedule x genotype interaction was also found. This interaction was found to be significant on each assessment date after 86 DAP in each canopy region where LLS in Florunner was greater than 0.1%. Because of this significant interaction, mean separations for fungicide schedules were performed individually for each genotype (Table 2). Orthogonal contrasts further amplified differences between selected spray schedules within Florunner, Southern Runner, and UF 81206 (Table 3).

Fungicide applications generally had no significant effect on the LLS in the late leafspot resistant Southern Runner, but did consistently decrease LLS in Florunner. The 10-day spray schedule did significantly decrease LLS in Southern Runner in the middle canopy at 97 DAP (Table 3) and in the top canopy on 135 DAP (Table 2 and 3). At no assessment date was there a significant decrease in LLS in any canopy region for UF 81206 attributable to fungicide application

Applications of fungicide on Florunner decreased the rate of late leafspot progress when compared to the rate in nonsprayed plots (Tables 4, 5 and 6; Figures 4 through 12). With Florunner in most instances, each increment in the amount of fungicide applied yielded a significant decrease in the rate of progress of late leafspot, but some exceptions to this trend were found (nontransformed LLS data from the bottom canopy, and Gompertz and logistic transformations in the top canopy). For Florunner, the rates of increase in LLS in the 10-day spray schedule plots were always significantly lower than those in the nonsprayed plots.

Table 2. The effect of fungicide schedule on late leafspot severity for each of three peanut genotypes when disease was assessed in each of three canopy layers. Data are shown for all dates on which significant genotype X fungicide treatment interactions were found in any canopy layer.

Genotype and fungicide spray interval	Late leafspot severity on individual assessment dates								
	86 DAP[w]			97 DAP			107 DAP	121 DAP	135 DAP
	Bottom[x]	Middle	Top	Bottom	Middle	Top	Top	Top	Top
Florunner									
Nonsprayed[y]	1.4 A	1.2 A[z]	0.14 A	12.13 A	10.8 A	6.1 A	[illegible] A	[illegible]	[illegible]
19-day	0.65 B	0.01 B	0.01 B	1.03 B	0.8 B	[illegible] B	[illegible]	[illegible]	[illegible]
9-day	0.01 C	0.001B	0.0003B	0.3 B	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Southern Runner									
Nonsprayed	0.04 A	0.02 A	0.003 A	1.11 A	[illegible]	[illegible]	[illegible]	[illegible]	4.0 A
19-day	0.01 A	0.004A	0.003 A	0.3 A	0.03 A	0.01 [illegible]	[illegible]	[illegible] A	1.5 AB
9-day	0.001 A	0.0001A	0.0001A	0.06 A	0.002A	[illegible]	[illegible]	[illegible] A	0.3 B
UF 81206									
Nonsprayed	0.0003A	0.002 A	0.003 A	0.2 A	0.2 A	0.13 A	1.0 A	1.7 [illegible]	[illegible]
19-day	0.0003A	0.004 A	0.0003A	0.1 A	0.01 A	0.001 A	0.1 A	1.4 A	0.6 [illegible]
9-Day	0.003 A	0.001 A	0.0001A	0.04 A	0.01 A	0.001 A	0 A	0.03 A	0.01A

w – Days after planting

x – Canopy layer in which late leafspot severity was assessed as percentage of leaf area affected.

y – Nonsprayed plots received no treatments for the control of peanut leafspot, while 9- and 19-day interval plots received applications of chlorothalonil (2.48 l/ha) on either a 9- or 19-day interval

z – Means within each genotype followed by different letters are significantly different according to the Newman-Keuls mean separation procedure at the 0.01 level.

Table 3. Results of preplanned orthogonal contrasts between mean late leafspot severity ratings from three different fungicide spray intervals on three peanut genotypes. Data are shown for each assessment date on which a significant genotype X fungicide schedule interaction was found to occur.

Cultigen and contrasted fungicide spray intervals^{w}	F ratios from preplanned orthogonal contrasts of late leafspot severity for each of five individual assessment dates								
	86 DAP^{x}			97 DAP			107 DAP	121 DAP	135 DAP
	Bottom	Middle	Top	Bottom	Middle	Top	Top	Top	Top
Florunner									
Nonsprayed vs 19-day	276^{a}^{y}	16.5^{a}	247^{a}	472^{a}	333^{a}	133^{a}	476^{a}	0.1^{n}	11
Nonsprayed vs 9-day	952^{a}	16.0^{a}	243^{a}	540^{a}	389^{a}	146^{a}	536^{a}	96.0^{a}	287^{a}
Southern Runner									
Nonsprayed vs 9-day	0.414^{n}	1.01^{n}	0.07^{n}	3.41^{n}	5.46^{b}	0.42^{n}	2.75^{n}	2.5^{n}	12.9^{a}
BF 81206									
Nonsprayed vs 9-day	0.004^{n}	0.002^{n}	0.01^{n}	0.08^{n}	0.11^{a}	0.1^{n}	2.08^{n}	2.5^{n}	1.79^{n}
Error DF^{z}	25	19	27	27	27	30	23.1	30	2[illegible]

w - Orthogonal contrasts between plots which received no fungicide for control of late leafspot and plots which received treatments with chlorothalonil (2.48 l/ha) with either a 9- or 19-day interval between applications.

x - Days after planting.

y - Level of significance of the contrast: a - 0.01 ; b - 0.05, n - not significant at 0.05 level.

z - Error degrees of freedom used in the contrast, calculated by Satterthwaite's procedure.

Table 4. Effect of fungicide schedule on late leafspot disease progress for each of three peanut genotypes in the bottom layer of the crop canopy as determined by linear regression techniques. Late leafspot severities were used in their nontransformed state and in logistic and Gompertz transformations.

Genotype and fungicide spray interval	Regression statistics[x]								
	Nontransformed			Logistic transformation			Gompertz transformation		
	Y_o	Slope	r^2	Y_o	Slope	r^2	Y_o	Slope	r^2
Florunner									
Nonsprayed[y]	-15.9	0.245a	0.586	-26.2	0.251a	0.946	-4.96	0.042a	0.925
19-day	-9.8	0.138a	0.429	-21.7	0.166b	0.852	-4.11	0.026b	0.834
9-day	-1.8	0.027b	0.305	-20.0	0.126b	0.745	-3.57	0.017c	[illegible]
Southern Runner									
Nonsprayed	-1.5	0.023a	0.326	-26.1	0.212a	0.865	-4.13	0.025a	0.816
19-day	-1.9	0.027a	0.352	-23.0	0.164a	0.818	-3.83	0.020a	0.818
9-day	-1.15	0.016a	0.247	-19.3	0.107b	0.648	-3.39	0.013b	0.635
UF 81206									
Nonsprayed	-0.78	0.011a	0.422	-22.1	0.146a	0.735	-3.63	0.017a	0.737
19-day	-0.25	0.004ab	0.265	-18.2	0.094a	0.563	-3.15	0.01ab	0.550
9-day	-0.10	0.002b	0.218	-16.6	[illegible]	[illegible]	[illegible]	0.008b	[illegible]

x - Y_o, slope, and r^2 are the estimated y-intercept, slope, and coefficient of determination of the regression line.

y - Regression slopes within each genotype/transformation group denoted by the same letter are [illegible] significantly different at the P = 0.05 level.

Table 5. Effect of fungicide schedule on late leafspot disease progress for each of three peanut genotypes in the middle layer of the crop canopy as determined by linear regression techniques. Late leafspot severities were used in their nontransformed state as well as in logistic and Gompertz transformations.

Genotype and fungicide spray interval	Regression statistics[x]								
	Nontransformed			Logistic transformation			Gompertz transformation		
	Y_o	Slope	r^2	Y_o	Slope	r^2	Y_o	Slope	r^2
Florunner									
Nonsprayed[y]	22.6	0.316a	0.666	-32.4	0.315a	0.947	-6.1	0.054a	0.941
19-day	-15.9	0.216b	0.598	-23.8	0.181b	0.940	-4.54	0.030b	0.919
9-day	-1.5	0.023c	0.340	-21.8	0.134c	0.704	-3.70	0.017c	[illegible]
Southern Runner									
Nonsprayed	-4.7	0.068a	0.756	-22.2	0.161a	0.887	-3.97	0.023a	0.898
19-day	-4.7	0.063a	0.510	-23.1	0.159a	0.902	-4.06	0.022a	0.879
9-day	0.6	0.009b	0.007	-20.5	0.096b	0.483	-3.36	0.010b	[illegible]
UF 81206									
Nonsprayed	-2.6	0.034a	0.723	-22.9	0.151a	0.854	-3.91	0.020a	0.861
19-day	-2.3	0.029ab	0.445	-22.0	0.136a	0.837	-3.83	0.018ab	0.797
[illegible]	-1.2	[illegible]	[illegible]	-21.2	0.112a	[illegible]	[illegible]	[illegible]	[illegible]

x - Y_o, slope, and r^2 are the estimated y-intercept, slope, and coefficient of determination of the regression line.

y - Regression slopes within each genotype/transformation group denoted by the same letter are not significantly different at the P = 0.05 level.

Table 4. Effect of fungicide schedule on late leafspot disease progress for each of three peanut genotypes in the top layer of the crop canopy as determined by linear regression techniques. Late leafspot severities were used in their nontransformed state as well as in logistic and Gompertz transformations.

Genotype and fungicide spray interval	Regression statistics[x]								
	Nontransformed			Logistic transformation			Gompertz transformation		
	Y_o	Slope	r^2	Y_o	Slope	r^2	Y_o	Slope	r^2
Florunner									
Nonsprayed[y]	-20.8	0.288a	0.766	-22.3	0.171a	0.796	-4.52	0.032a	[illegible]
19-day	-15.8	0.197b	0.677	-24.7	0.178a	0.923	-4.70	0.030a	0.940
9-day	-1.23	0.017c	0.600	-22.6	0.139b	0.797	-3.74	0.017b	0.790
Southern Runner									
Nonsprayed	-5.23	0.063a	0.770	-24.3	0.167a	0.853	-4.29	0.024a	0.899
19-day	-2.8	0.034b	0.626	-25.9	0.170a	0.811	-4.30	0.022a	0.825
9-day	-0.13	0.0022a	0.026	-20.1	0.084b	0.218	3.22	0.0081b	0.150
UF 81206									
Nonsprayed	-2.39	0.030a	0.571	-24.9	0.165a	0.796	-4.14	0.021a	0.804
19-day	-1.41	0.017ab	0.364	-26.5	0.165a	0.827	4.17	0.020a	0.783
9-day	[illegible]	0.012b	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.020a	[illegible]

x - Y_o, slope, and r^2 are the estimated y intercept, slope, and coefficient of determination of the regression line.

y - Regression slopes within each genotype/transformation group denoted by the same letter are not significantly different at the P = 0.05 level.

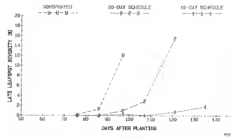

Figure 4. The progress of late leafspot on Florunner in the bottom canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10-and 20-day schedule, respectively).

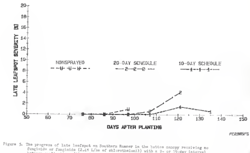

Figure 5. The progress of late leafspot on Southern Runner in the bottom canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

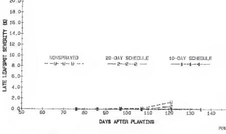

Figure 6. The progress of late leafspot on UF 81206 in the bottom canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

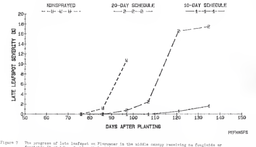

Figure 7 The progress of late leafspot on Florunner in the middle canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

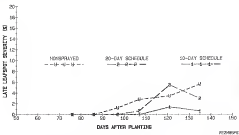

Figure 6. The progress of late leafspot on Southern Runner in the middle canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

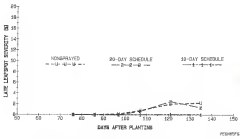

Figure 9. The progress of late leafspot on UF 81206 in the middle canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

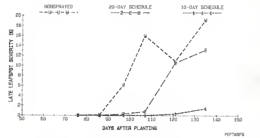

Figure 10. The progress of late leafspot on Florunner in the top canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

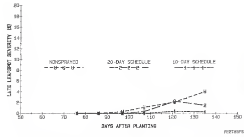

Figure 11. The progress of late leafspot on Southern Runner in the top canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

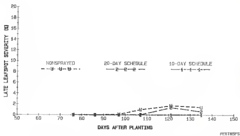

Figure 12. The progress of late leafspot on UF 81206 in the top canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

The application of fungicide on a 10-day spray schedule significantly reduced the rate of late leafspot progress in Southern Runner when compared to the rate in the nonsprayed plots, but applications on a 20-day schedule did not. The latter application schedule significantly slowed the rate of increase of LLS in only one instance (Table 6, untransformed data).

The response to fungicide application was less dramatic on UF 81206 than on the other genotypes. Significant reductions in the rate of late leafspot progress were found only when the 10-day schedule was compared with the nonsprayed schedule (Tables 4, 5, and 6). These reductions were inconsistent and varied with the transformation used. Four of the nine tests performed on UF 81206 showed no significant differences between rates of disease progress among the three fungicide schedules.

Defoliation. In contrast to the LLS data, defoliation in fungicide-treated peanuts was usually higher in UF 81206 and Southern Runner than that in plots of Florunner for equivalent treatments (Table 7). Analysis of variance for defoliation throughout the total canopy (overall defoliation) and within each canopy region showed the presence of significant fungicide schedule x genotype interactions, as was the case for the LLS data (Tables 7 and 8). Where these significant interactions were found, defoliation in the middle and top canopy regions in the nonsprayed plots of Florunner always exceeded that of nonsprayed plots of Southern Runner and UF 81206. In assessments made 86 and 97 DAP, where interactions were significant, both the fungicide schedule and genotype main effects in the statistical model were significant as well. Southern Runner and UF 81206 had higher

Table 7. The effect of fungicide schedule on defoliation for each of three peanut genotypes. Data are shown for each assessment date on which significant genotype x fungicide schedule interactions were found.

Genotype and fungicide spray interval	Percent defoliation at intervals after planting											
	86 DAP		97 DAP			107 DAP			121 DAP			135 DAP
	Over-all	Bottom[x]	Over-all	Bottom	Middle	Over-all	Middle	Top	Over-all	Bottom	Top	Top
Florunner												
Nonsprayed[y]	22.9A[z]	83.7A	39.1A	100 A	58.1A	67.5A	100 A	34.0A	87.0A	100 A	75.3A	74.2A
19-day	15.1B	56.9B	19.0B	75.0B	2.5B	20.2B	6.9B	21.4B	49.5B	100 A	16.1B	42.1B
9-day	11.9B	43.1B	13.3B	55.0C	0 B	15.7B	0 B	7.4C	13.5C	63.1B	0 B	0 C
Southern Runner												
Nonsprayed	25.4A	88.1A	34.4A	98.1A	4.3A	60.5A	93.8A	0	80.1A	100 A	62.1A	59.6A
19-day	18.4B	65.0B	20.8B	81.9B	2.5B	25.6B	18.1B	0	72.5A	100 A	44.5B	55.5A
9-Day	15.2B	53.8B	16.7B	63.8C	1.3B	19.9B	8.9B	0	21.0B	80.6B	0.4C	3.0B
UF 81206												
Nonsprayed	28.7A	86.0A	32.2A	93.8A	14.4A	45.8A	68.8A	0	75.9A	100 A	53.5A	52.2A
19-day	24.6A	75.0A	24.5B	81.8A	3.1A	28.4B	13.8B	0	66.4A	100 A	35.0B	49.6A
9-day	20.0A	83.9A	25.5AB	93.3A	9.4A	25.3B	8.1B	0	29.3B	97.4A	1.5C	3.7B

x - Canopy layer (bottom, middle, top or overall) in which defoliation was assessed.

y - Nonsprayed plots received no fungicides for the control of late leafspot, 9- and 19-day plots received applications of chlorothalonil (2.48 l/ha) on either a 9- or 19-day interval.

z - Means within a genotype/assessment date/canopy region group followed by different letters are significantly different (P = 0.01) according to Newman-Keuls mean separation procedure.

Table 8. Results of preplanned orthogonal contrasts between mean percentage defoliation for selected gicide schedules within each of three genotypes. Contrasts were performed using data from assessment date on which a significant genotype x fungicide schedule interaction was found.

Genotype and spray intervals contrasted[x]	F ratios from preplanned orthogonal contrasts of mean defoliation on five individual assessment dates											
	86 DAP		97 DAP			107 DAP			121 DAP			135 DAP
	Over-all	Bottom	Over-all	Bottom	Middle	Over-all	Middle	Top	Over-all	Bottom	Top	Top
Florunner												
Nonsprayed vs 19-day	16.5^{a}[y]	15.7^{a}	99.3^{a}	21.3^{a}	141.0^{a}	167.0^{a}	177.0^{a}	88.5^{a}	104.0^{a}	0.0^{n}	104.0^{a}	29.[illegible]
Nonsprayed vs 9-day	32.6^{a}	36.5^{a}	164.0^{a}	69.1^{a}	154.0^{a}	201.0^{a}	204.0^{a}	19.9^{a}	402.0^{a}	126.3^{a}	168.0^{a}	135.0^{a}
Southern Runner												
Nonsprayed vs 9-day	28.4^{a}	27.0^{a}	77.2^{a}	40.1^{a}	73.1^{a}	124.0^{a}	147.8^{a}	0^{n}	259.0^{a}	35.2^{a}	111.0^{a}	29.2^{a}
UF 81206												
Nonsprayed vs 9-day	0.1^{n}	0.1^{n}	3.3^{n}	0.01^{n}	1.1^{n}	31.7^{a}	75.3^{a}	0^{a}	161.0^{a}	0.6^{n}	32.8^{a}	52.1^{a}
Error DF[z]	27	27	30	17	29	26	29	29	27	30	26	30

[x] - Orthogonal contrasts between plots which received no fungicide for control of late leafspot and plots which received treatments with chlorothalonil (2.48 l/ha) with either a 9- or 19 day interval between applications.

[y] - Level of significance of the contrast: a - 0.01; n - not significant at 0.01 or 0.05 level.

[z] - Error degrees of freedom used in the contrast, calculated by Satterthwaite's procedure.

defoliation levels than Florunner when no significant fungicide schedule x genotype interaction occurred (Table 9).

Fungicide applications in Florunner usually resulted in dramatic decreases in defoliation that were not seen in Southern Runner and UF 81206 (Table 7 and 8, Figures 13 through 21), causing the significant fungicide schedule x genotype interactions in the analyses of variance. Further, the F ratios in the nonsprayed and 10-day schedule contrasts are always smaller within Southern Runner and UF 81206 than within Florunner (Table 8). Where significant fungicide schedule x genotype interactions were found in analysis of variance of defoliation data, defoliation in nonsprayed treatments of Florunner was significantly different from defoliation in Florunner 20-day schedule plots 10 out of 12 times, where in UF 81206 nonsprayed and 20-day schedule defoliation means were significantly different only three out of 12 times (Table 7). Treatment means for nonsprayed Southern Runner were significantly different from 20-day schedule means eight out of the 12 times when significant fungicide schedule x genotype interactions were found. Further, Figure 15 shows that defoliation of UF 81206 in the bottom canopy did not respond to fungicide applications in a significant manner. In other canopy regions, UF 81206 did respond to fungicide application with lower defoliation, as did Southern Runner and Florunner in all canopy regions (Figures 13, 14, and 16 through 21).

Relationship between LLS and defoliation. The number of significant positive correlations between LLS and defoliation was progressively less among Florunner, Southern Runner, and UF 81206, respectively (Table 10). Of 11 correlations between LLS and defoliation in

Table 9. Effect of genotype and fungicide application schedule on defoliation by canopy region for each assessment date on which no significant genotype X fungicide schedule interaction was found.

		Percent defoliation at individual sampling dates							
		65 DAP		76 DAP		86 DAP	121 DAP	135 DAP	
Main effect	Treatment	Overall^x	Bottom	Overall	Bottom	Middle	Middle	Overall	Middl
Genotype						ns		ns	ns
	Florunner	11.9B^y	28.9B	14.6C	45.1C		62.3A		
	Southern Runner	12 5B	31.0B	19.8B	59.2B		71.3A		
	UF 81206	26.5A	63.0A	29.4A	75.4A		72.7A		
Fungicide spray interval		ns	ns	ns	ns				
	Nonsprayed^z					3.9A	100 A	82.2A	100 A
	19-day interval					0.8B	93.3A	76.8A	100 A
	9-day interval					0.6B	12.9B	27.9B	31.7B

x - Canopy region in which assessment was made, overall region was defoliation throughout the canopy.

y - Means followed by a different letter are significantly different according to the Newman-Keuls separation technique.

z - Nonsprayed plots received no treatments for control of peanut leafspot, while 9- and 19-day int plots received applications of chlorothalonil (2.48 l/ha) on either a 9- or 19 day interval.

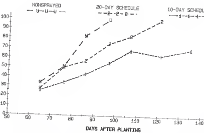

Figure 13. The progress of defoliation in Florunner in the bottom canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

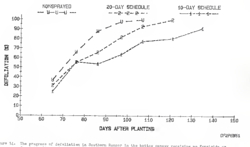

Figure 14. The progress of defoliation in Southern Runner in the bottom canopy receiving no fungicide or fungicide (2.4% L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

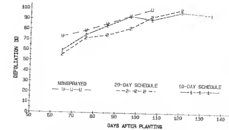

Figure 15. The progress of defoliation in UF 81206 in the bottom canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

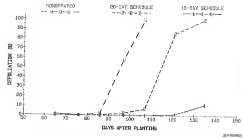

Figure 16. The progress of defoliation in Florunner in the middle canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10 and 20-day schedule, respectively).

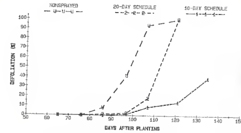

Figure 17. The progress of defoliation in Southern Runner in the middle canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

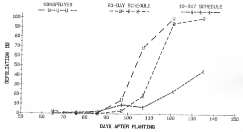

Figure 18. The progress of defoliation in UF 81206 in the middle canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

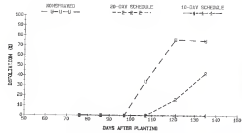

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Figure 19. The progress of defoliation in Florunner in the top canopy receiving no fungicide or fungicide (2.43 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

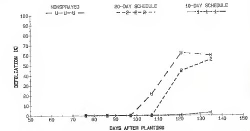

Figure 20. The progress of defoliation in Southern Runner in the top canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively).

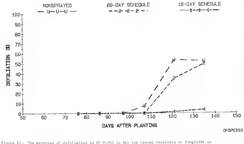

Figure 21. The progress of defoliation in UF 81206 in the top canopy receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9 or 19-day interval between applications (10- and 20-day schedule, respectively).

Table 10. Correlations between late leafspot severity and defoliation for each of three canopy layers within three peanut genotypes on five sampling dates.

DAP[w]	Canopy region	Florunner	Southern Runner	UF 81206
86	Bottom	.795[x] (.002)[y]	.644 (.023)	.504 (.094)
	Middle	.554 (.061)	NT[z]	NT
97	Bottom	.846 (<.001)	.621 (.031)	.202 (1.0)
	Middle	.888 (<.001)	.972 (<.001)	.479 (.115)
107	Bottom	.804 (.016)	.428 (.290)	.596 (.052)
	Middle	.646 (.083)	.840 (<.001)	.835 (<.001)
	Top	.971 (<.001)	.752 (.004)	.982 (<.001)
121	Bottom	.902 (.013)	.737 (.155)	-.024 (1.000)
	Middle	.996 (<.001)	.857 (<.001)	.853 (<.001)
	Top	.591 (.043)	.816 (.001)	.811 (.001)
135	Middle	NT	.738 (.058)	.666 (.018)
	Top	.858 (<.001)	.716 (.008)	.756 (.004)

w - Number of days after planting when disease and defoliation were rated.
x - Correlation coefficient
y - Probability of a greater F ratio; correlation significant if ≤ 0.05.
z - Not tested because of low amounts of disease or defoliation or because of total defoliation in the canopy region.

Florunner, nine were significant ($P \leq 0.05$). A significant relationship between LLS and defoliation was found for Florunner in all canopy regions with a mean correlation coefficient of 0.81. Correlations of LLS and defoliation in Southern Runner were significant in eight of 11 tests performed and the mean correlation coefficient was 0.74. The relationship of these variables was more significant in the middle and top canopy regions in Southern Runner. In UF 81206 the correlations between LLS and defoliation were significant in six of 11 tests with a mean correlation coefficient of 0.61. Late leafspot severity was not significantly correlated with defoliation in UF 81206 in the bottom canopy, but significant correlations existed in the middle and top canopy regions. There were no significant correlations between LLS and defoliation in any genotype at 65 and 76 DAP.

Leaf area accumulation. Generally, Southern Runner and UF 81206 maintained higher amounts of leaf area than did Florunner (Figures 22, 23, 24, and 25). The bottom canopy leaf area index in each genotype was negligible compared to the other canopy regions, as the highest leaf are index measured was less than 0.5. Leaf area in the middle canopy decreased in all genotypes after 65 DAP (Figure 24), coinciding with the beginning of the accumulation of larger amounts of reproductive biomass or pod weight (Figure 26). Leaf area index values in the top canopy region began to decline at the same date as did leaf area in the middle canopy region, but Southern Runner and UF 81206 maintained greater amounts of leaf area than did Florunner. The top canopy region in all genotypes had the highest LAI values and because of this, the total canopy leaf area accumulation over time closely follows the trends seen in the top canopy region (Figure 22).

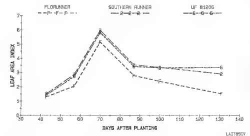

Figure 22. Changes in leaf area index for the total canopy of Florunner, Southern Runner, and UF 81206 (values averaged over three fungicide schedules).

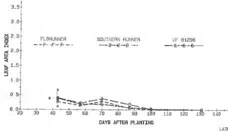

Figure 23. Changes in leaf area index in the bottom canopy of Florunner, Southern Runner, and UF 81206 (values averaged over three fungicide schedules) [Points on the same date labeled with different letters are significantly different (0.05) according to Newman-Keuls mean separation procedure).

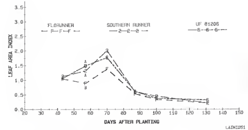

Figure 24. Changes in leaf area index in the middle canopy of Florunner, Southern Runner, and UF 81206 (values averaged over three fungicide schedules) [Points on the same date labeled with different letters are significantly different (0.01) according to Newman-Keuls mean separation procedure].

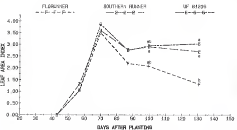

Figure 25. Changes in leaf area index in the top canopy region of Florunner, Southern Runner, and UF 81206 (values averaged over three fungicide schedules) [Points on the same date labeled with different letters are significantly different (0.05) according to Newman-Keuls mean separation procedure].

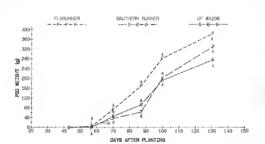

Figure 26. Changes in pod weight in Florunner, Southern Runner, and UF 81206 (values averaged over three fungicide schedules) [points on the same date labeled with different letters are significantly different (0.01) according to Newman-Keuls mean separation procedure]

Fungicide applications significantly increased LAI of all three genotypes late in the growing season for the middle, top and total canopy regions (Figures 27, 28, and 29). However, bottom canopy LAI was significantly increased by the 10-day fungicide schedule at 87 DAP (Figure 30).

Although significant fungicide schedule x genotype interactions existed in LAI assessment, no significant differences were found between fungicide schedule means with the genotype (Table 11).

Correlations between defoliation and LAI assessments show that the relationship between these variables is inconsistent (Table 12). A significant negative correlation between defoliation and leaf area index existed four of nine, five of nine, and six of nine tests for Florunner, Southern Runner, and UF 81206, respectively (Table 12). When genotypes were combined for testing for a significant correlation between defoliation and LAI, a reduction in the correlation coefficient occurred even if the correlation was significant for all three genotypes.

The correlation between LAI and LLS within the three genotypes was more variable than the correlation between defoliation and LAI assessments (Table 12). There was no date or canopy region where the correlation between LAI and LLS was significant for all genotypes tested. The correlation between LAI and LLS was only significant later in the growing season (97 and 131 DAP) and was significant more often on Florunner (two of five times) than on Southern Runner (one of five times) or UF 81206 (one of five times).

There was no significant effect of genotype or fungicide schedule on the total number of nodes formed or in the increase in the number

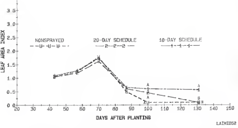

Figure 27. The effect of fungicide schedule on changes in leaf area index in the middle canopy (values averaged over three peanut genotypes) [Points on the same date labeled with different letters are significantly different (0.01) according to Newman-Keuls mean separation procedure]

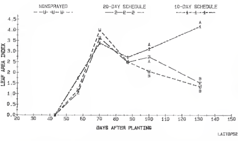

Figure 28. The effect of fungicide schedule on changes in leaf area index in the top canopy (values averaged over three peanut genotypes) [Points on the same date labeled with different letters are significantly different (0.01) according to Newman-Keuls mean separation procedure].

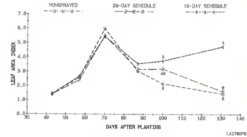

Figure 29. The effect of fungicide schedule on changes in leaf area index of the total canopy (values averaged over three peanut genotypes) (Points on the same date labeled with different letters are significantly different (0.01) according to Newman-Keuls mean separation procedure).

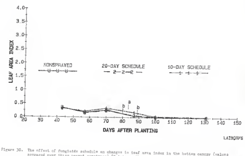

Figure 30. The effect of fungicide schedule on changes in leaf area index in the bottom canopy (values averaged over three peanut genotypes) [Points on the same date labeled with different letters are significantly different according to Newman-Keuls mean separation procedure].

Table 11. Effect of fungicide application schedule on leaf area index (LAI) for each of three peanut genotypes for assessment dates on which significant fungicide schedule X genotype interactions were found.

Genotype	Fungicide spray interval[x]	43 DAP[w]		70 DAP
		Middle canopy LAI[y]	Total LAI	Total LAI
Florunner	Nonsprayed	1.04 A[z]	1.30 A	6.35 A
	19-day	0.81 A	1.00 A	4.03 A
	9-day	1.28 A	1.62 A	5.11 A
Southern Runner	Nonsprayed	1.04 A	1.43 A	5.37 A
	19-day	1.26 A	1.68 A	6.64 A
	9-day	1.09 A	1.48 A	5.95 A
UF 81206	Nonsprayed	1.15 A	1.55 A	6.29 A
	19-day	1.10 A	1.58 A	5.87 A
	9-day	0.93 A	1.21 A	5.33 A

w - Days after planting, fungicide spray schedules initiated 43 DAP

x - Nonsprayed plots received no applications of fungicide to control late leafspot, 9- and 19-day plots received applications of chlorothalonil (2.48 l/ha) on a 9- or 19-day schedule, respectively.

y - LAI measured in cm^2.

z - Means in a column folowed by different letters are significantly different (P = 0.05) according to the Newman-Keuls mean separation procedure.

Table 12. Correlation between defoliation and leaf area index (LAI) and between late leafspot severity and LAI for each of three peanut genotypes on four assessment dates. Data are shown for all canopy regions in which some defoliation had occurred, but which were not completely defoliated.

		Correlation between defoliation and LAI			Correlation between late leafspot severity and LAI		
DAP[x]	Canopy region	Florunner	Southern Runner	UF 81206	Florunner	Southern Runner	UF 81206
65(70)	Overall	.326[y](.300)[z]	-.327(.298)	.617(.032)			
	Bottom	.188(1.000)	-.729(.007)	-.201(1.000)	-.164(1.000)	.543(.067)	-.064(1.000)
86(70)	Overall	-.204(1.000)	-.363(.337)	-.304(.337)			
	Bottom	-.577(.063)	-.489(.182)	-.468(.124)	-.516(.103)	[illegible]	[illegible]
97(100)	Overall	-.828(<.001)	-.753(.007)	.015(1.000)			
	Bottom	-.513(.088)	-.576(.063)	.227(1.000)	-.345(.271)	-.356(.282)	[illegible]
	Middle	-.737(.006)	-.764(.006)	-.018(1.000)	-.794(.002)	-.822(.001)	[illegible]
135(131)	Overall	-.991(<.001)	-.88 (.02)	-.949(.003)			
	Top	-.867(.025)	-.960(.002)	-.960(.002)	-.981(<.001)	-.683(.134)	-.81[illegible]

x - First number is the number of days after planting when late leafspot severity and defoliation were assessed, the number in parentheses is the number of days after planting when samples were drawn to determine LAI.

y - Calculated correlation coefficient.

z - Probability of a greater F ratio; correlation significant if ≤ 0.05.

of nodes between consecutive assessment dates (Table 13). An increase number of nodes was found to occur in all genotypes until the 121 DAP assessment date.

Reproductive biomass accumulation. The time of initiation of pod fill was the same for Florunner, Southern Runner, and UF 81206 (Figure 26), but the pod weights after 56 DAP were always higher in Florunner. A significant effect of fungicide schedule on pod weight occurred at 87 DAP, with the 10-day schedule mean being significantly different (Newman-Keuls mean separation, $P \leq 0.05$) from the other fungicide schedule means (nonsprayed, 20-day, and 10-day schedule pod weights were 90.7, 108.5, and 129.9 g, respectively).

Harvest index values (PWT/TWT) for Florunner were consistently significantly greater than those of Southern Runner and UF 81206, indicating that a larger portion of the biomass of the plant was concentrated in the pods in Florunner (Figure 31). At no date was there a significant effect of fungicide schedule on harvest index, showing that LLS did not affect distribution of biomass.

Diseased leaf area. Florunner had higher amounts of diseased leaf area (DLA) in all canopy regions than did Southern Runner and UF 81206 (Figures 32 through 35). Significant fungicide schedule x genotype interactions occurred in the analyses of variance of DLA the last three assessment dates as DLA was consistently reduced with fungicides on Florunner but not on the other genotypes (Tables 14 and 15). In the canopy regions where this interaction was significant at 86 and 97 DAP, both main effects in the statistical model were significant as well. At 135 DAP only the fungicide schedule x genotype interaction and genotype effects were found to be significant. There [illegible] Mean number of nodes per main stem for each of three peanut genotypes at intervals after planting.

	Genotype			
[illegible]	Florunner	Southern Runner	UF 81206	Overall
[illegible]	13.3	12.6	12.9	13.0
[illegible]	15.2	15.0	15.3	15.2
[illegible]	18.3	18.2	18.5	18.4
97	20.6	20.1	20.8	20.5
107	22.2	22.0	23.2	22.5
121	24.2	24.6	25.4	24.9
135	23.5	23.5	24.6	23.8

x - Number of days after planting.

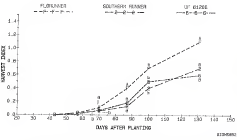

Figure 31. Changes in the harvest index of Florunner, Southern Runner, and UF 81206 (values averaged over three fungicide schedules) (Points labeled with different letters are significantly different (0.01 and 0.05 upper and lower case letters, respectively) according to Newman-Keuls mean separation procedure].

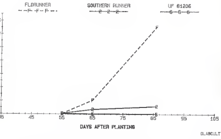

Figure 32. The progress of diseased leaf area of Florunner, Southern Runner, and UF #1206 in the bottom canopy.

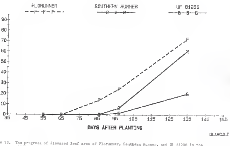

Figure 33. The progress of diseased leaf area of Florunner, Southern Runner, and UF 81206 in the middle canopy.

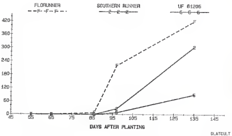

Figure 34. The progress of diseased leaf area of Florunner, Southern Runner, and UF 81206 in the top canopy.

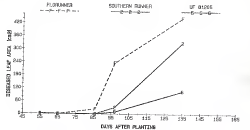

Figure 35. The progress of diseased leaf area of Florunner, Southern Runner, and UF 81206 in the total canopy.

Table 14. Effect of fungicide application on diseased leaf area for each of three peanut genotypes on three assessment dates. Data are shown for each canopy region in which complete defoliation had not yet occurred.

Genotype and fungicide spray interval[x]	Diseased leaf area (cm^2)								
	86[y] (87)[y] DAP				97 (100) DAP			135 (131) DAP	
	Bottom	Middle	Top	Total	Middle	Top	Total	Top	Total
Florunner									
Nonsprayed	3.65 A[z]	41.63 A	25.42 A	68.88A	50.49A	600.24A	625.49A	114.13B	114.15B
19-day	0.18 B	0.356B	0.357B	1.39B	23.10B	57.6 B	80.70B	806.13A	806.13A
9-day	0.094 B	0.006B	0.076B	0.18B	0.17C	0.02B	0.38B	337.91B	410.06B
Southern Runner									
Nonsprayed	0.312 A	0.708A	0.661A	1.6 A	17.95A	77.92A	89.88A	650.07A	692.90A
19-day	0.03 A	0.356A	1.174A	1.56A	1.55B	1.53A	3.62A	225.07B	225.08B
9-day	0.01 A	0.003A	0.022A	0.03A	0.09B	0.02A	0.41A	33.17B	69.00B
UF 81206									
Nonsprayed	0.001 A	0.094A	0.821A	0.92A	4.84A	26.61A	30.29A	171.09A	198.10A
19-day	0.005 A	0.105A	0.072A	0.19A	0.07A	0.14A	0.32A	100.58A	117.08A
9-day	0.0001A	0.018A	0.013A	0.04A	0.27A	0.23A	0.61A	0.89A	2.03A

x - Nonsprayed plots received no applications of fungicides for control of late leafspot, while 9- and 19-day plots received applications of chlorothalonil (2.48 l/ha) on a 9- or 19-day schedule.

y - Number of days after planting on which disease severity was assessed and, in parentheses, number of days after planting on which samples were drawn for determination of LAI.

z - Means in a genotype-canopy region group followed by the same letter are not significantly different at the P = 0.01 level, according to the Newman-Keuls mean separation procedure.

Table 15. Results of preplanned orthogonal contrasts between diseased leaf areas^{x} under different fungicide application schedules in each of three peanut genotypes. Data are shown for each of three assessment dates for those canopy regions in which a significant fungicide schedule x genotype interaction was found.

Genotype and fungicide spray intervals contrasted	Calculated F ratios for contrasts of diseased leaf area at intervals after planting								
	86^{y} $(87)^{y}$ DAP				97 (100) DAP			135 (131) DAP	
	Bottom	Middle	Top	Total	Middle	Top	Total	Top	Total
Florunner									
Nonsprayed vs. 19-day	^{z} 363^{a}	31.4^{a}	21.3^{a}	33.9^{a}	50.4^{a}	47.4^{a}	47.7^{a}	55.4^{a}	60.3^{a}
Nonsprayed vs. 9-day	381^{a}	30.9^{a}	22.7^{a}	35.5^{a}	120.0^{a}	57.9^{a}	62.8^{a}	5.79^{b}	11.0^{a}
Southern Runner									
Nonsprayed vs. 9-day	2.8^{n}	0.01^{n}	0.01^{n}	0.02^{a}	21.4^{a}	0.98^{n}	1.29^{n}	44.03^{a}	49.0^{a}
UF 81206									
Nonsprayed vs. 9-day	0.00002^{n}	0.0001^{n}	0.02^{n}	0.01^{a}	1.4^{a}	0.11^{n}	0.14^{n}	3.35^{n}	4.84^{n}
Error DF	30	29	30	30	30	26	25	16	16

x - Calculated by multiplying the late leafspot severity in a canopy region (expressed as a proportion) by the leaf area in that canopy region.

y - Number of days after planting when disease severity was assessed and, in parentheses, number of days after planting when leaf area was assessed.

z - Level of significance of the contrast: a - significant at P = 0.01 level, b - significant at P = 0.05 level; n - not significant at P = 0.05 level.

was no significant decrease in the amount of DLA in UF 81206 because of fungicide application at any assessment date. Previous to 135 DAP in Southern Runner, no significant decrease in DLA occurred because of fungicide applications. Significantly decreased DLA at 135 DAP in Florunner in the nonsprayed treatment was attributed to the great amounts of leaf area lost to defoliation.

Diseased leaf area was found to increase at a significantly greater rate in Florunner than in UF 81206 in the bottom and middle canopy regions (Table 16). Diseased leaf area in Florunner accumulated at significantly higher rates than in Southern Runner in the bottom (nontransformed data) and the middle canopy (log and special Gompertz transformed data).

The rate of DLA accumulation in the top canopy in Southern Runner and UF 81206 was higher than that in Florunner (Table 16), a trend completely different than that seen in evaluation of disease progress using LLS. Although the rates of DLA accumulation were higher in the resistant genotypes, there were no significant differences demonstrated among the rates of DLA increase within the genotypes.

Individual leaf assessment. Florunner leaves remained on the plant longer compared with the other genotypes early in the growing season (34 to 86 DAP), leaves on Southern Runner and UF 81206 had greater longevity than Florunner leaves later in the season (107 DAP) (Figure 36). Differences between RMAX in nonsprayed Southern Runner and UF 81206 compared with nonsprayed Florunner were accentuated in leaves emerging 97 and 107 DAP (Figures 37 through 39).

Analysis of the leaf survival periods reveals that a major effect of fungicide applications is an increase in the average period of time

Table 16. Effect of genotype on diseased leaf area progress as determined by means of simple linear regression techniques. Analyses were performed for each canopy region in unprotected plots of each of three peanut genotypes.

Canopy region and Genotype	Regression of diseased leaf area on time[x]								
	Nontransformed			Log10 transformation			Special Gompertz transformation[x]		
	Y_o	Slope	r^2	Y_o	Slope	r^2	Y_o	Slope	r^2
Bottom									
Florunner	-6.93	0.118a[y]	0.832	- 6.91	0.087a	0.889	- 3.68	0.019a	0.918
Southern Runner	-0.67	0.011b	0.390	- 6.65	0.068ab	0.738	- 3.45	0.012ab	0.738
UF 81206	0.15	0.003b	0.394	- 3.81	0.022b	0.262	- 2.94	0.004b	0.286
Middle									
Florunner	-108.4	1.69a	0.656	- 6.94	0.094a	0.855	- 4.14	0.027a	0.849
Southern Runner	-55.3	0.824a	0.663	- 4.86	0.055b	0.867	- 3.41	0.014b	0.874
UF 81206	-23.8	0.335b	0.383	- 4.05	0.038b	0.626	- 3.17	0.009b	[illegible]
Top									
Florunner	-101.7	3.41[z]	0.066	- 3.29	0.049a	0.516	- 3.12	0.016a	0.707
Southern Runner	-935.8	11.23a	0.827	- 5.26	0.062a	0.795	- 4.19	0.024a	0.866
UF 81206	-244.9	2.95b	0.746	- 5.00	0.055a	0.682	- 3.77	0.018a	0.730

x - Nontransformed diseased leaf area (DLA) was calculated for a given sampling date by multiplying the late leafspot severity in each canopy region on that date by the leaf area (cm^2) in that region. Log_{10} transformed DLA was log_{10} (DLA), and special Gompertz DLA was (-ln (-ln (DLA / 10000))).

y - Regression slopes within each canopy layer/transformation group denoted by the same letter do not differ significantly at the P = 0.05 level.

z - Not included in test because of poor fit of the model.

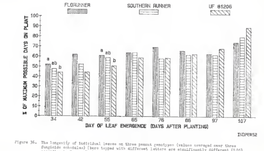

Figure 36. The longevity of individual leaves on three peanut genotypes (values averaged over three fungicide schedules) [bars topped with different letters are significantly different (0.05) according to Newman-Keuls mean separation procedure](maximum time = 139 days - day of emergence).

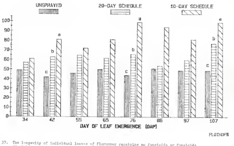

Figure 37. The longevity of individual leaves of Florunner receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively)(bars topped with different letters are significantly different (0.05) according to Newman-Keuls mean separation procedure)(maximum time = 139 days - day of emergence).

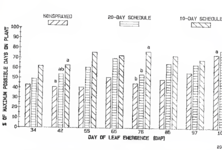

Figure 38. The longevity of individual leaves of Southern Runner receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively)(bars topped with different letters are significantly different (0.05) according to Newman-Keuls mean separation procedure)(maximum time - 139 days - day of emergence).

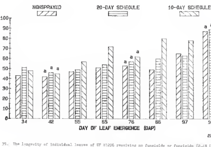

Figure 39. The longevity of individual leaves of UF 81206 receiving no fungicide or fungicide (2.48 L/ha of chlorothalonil) with a 9- or 19-day interval between applications (10- and 20-day schedule, respectively)[bars topped with different letters are significantly different (0.05) according to Newman-Keuls mean separation procedure](maximum time = 139 days [illegible] day of emergence).

each leaf remains on the plant. Attributable in large part to the response of Florunner to fungicide sprays, a significant effect on ZMAX was found for fungicide schedule for every tagging date after 34 DAP. Leaves tagged on 86 and 97 DAP responded significantly to only the applications at 10-day schedule (Figure 40).

Generally, leaf longevity on Florunner was greatly increased by fungicide application when compared to the responses in Southern Runner and UF 81206, particularly late in the growing season (Figures 37 through 39). Significant interactions between fungicide schedule and genotype occurred in analyses of variance of ZMAX (42, 76, and 107 DAP) because of the lack of significant increases in ZMAX with increased fungicide applications on UF 81206 and an intermediate overall response on Southern Runner (Table 17).

The maximum amount of disease assessed before leaf abscission (MAXDIS) was significantly reduced on Southern Runner and UF 81206 when compared with Florunner (Figure 41). Significant fungicide schedule x genotype interactions occurred in the analyses of variance of MAXDIS at 55 and 107 DAP because fungicide applications did not significantly reduce MAXDIS on Southern Runner and UF 81206 but did so on Florunner (Table 18).

A significant effect of fungicide schedule without a significant fungicide schedule x genotype interaction on MAXDIS was found at 65 DAP (Figure 42). There were no significant ($P \leq 0.05$) correlations between MAXDIS and ZMAX when all genotypes and fungicide schedules were used in the correlation procedure. When correlations between MAXDIS and ZMAX were done within individual genotypes, a significant

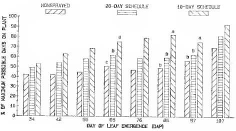

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Figure 40. The effect of three fungicide schedules on the longevity of individual leaves (values averaged over three peanut genotypes) [bars topped with different letters are significantly different (0.05) according to Newman-Keuls mean separation procedure](maximum time = 139 days - day of emergence).

Table 17. Effect of fungicide application schedule on leaf longevity for each of three peanut genotypes. Data are shown for each assessment date on which a significant fungicide schedule X genotype interaction was found.

Genotype	Fungicide spray interval[x]	Leaf longevity as a percentage of number of days remaining until harvest for three cohorts of newly emerged leaves 42 DAP[y]	76 DAP	107 DAP
Florunner	Nonsprayed	42.4c[z]	44.2c	49.2c
	19-day	63.3b	66.4b	76.5b
	9-day	80.9a	99.2a	98.5a
Southern Runner	Nonsprayed	47.4b	44.5b	73.5a
	19-day	53.5ab	54.3b	77.8a
	9-day	62.5a	76.6a	87.9a
UF 81206	Nonsprayed	42.4a	52.8a	87.1a
	19-day	45.9a	56.7a	88.6a
	9-day	45.4a	61.7a	92.4a

x - Nonsprayed plots received no applications of fungicide for the control of late leafspot, 9- and 19-day plots received applications of chlorothalonil (2.48 l/ha) on a 9- or 19-day schedule, respectively.

y - Number of days after planting (DAP) on which cohort was fully expanded. Maximum number of days was based on a harvest date 139 DAP.

z - Means in a column followed by different letters are significantly different (P = 0.05) level according to the Newman-Keuls mean separation procedure.

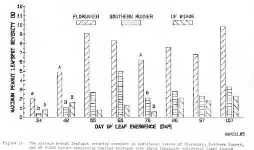


Figure 41. The maximum peanut leafspot severity assessed on individual leaves of Florunner, Southern Runner, and UF 81206 before abscission (values averaged over three fungicide schedules) [bars topped with different letters were significantly different (0.01 and 0.05 upper and lower case, respectively) according to Newman-Keuls mean separation procedure].

Table 18. Effect of fungicide application schedule on the maximum leafspot severity prior to defoliation on leaves tagged at emergence.

Genotype	Fungicide spray interval[w]	Maximum leafspot severity	
		55 DAP[x]	107 DAP
Florunner	Nonsprayed	15.0 a[y]	7.5 B[y]
	19-day	9.3 b	18.8 A
	9-day	3.0 c	3.0 B
Southern Runner	Nonsprayed	2.0 a	4.0 A
	19-day	4.3 a	4.5 A
	9-day	1.8 a	1.5 A
UF 81206	Nonsprayed	1.8 a	3.5 A
	19-day	0.4 a	3.0 A
	9-day	0.3 a	0.3 A

w - Nonsprayed plots received no applications of fungicide for the control of peanut leafspot, 9- and 19-day plots received applications of chlorothalonil (2.48 l/ha) on a 9- or 19-day schedule, respectively.

x - Days after planting.

y - Means in a column followed by different letters are significantly different at the P = 0.05 level (small letter) or the P = 0.01 level (capital letter), according to the Newman-Keuls mean separation procedure.

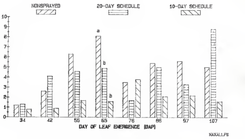


Figure 42. The effect of fungicide schedule on the maximum peanut leafspot severity assessed on individual leaves before abscission (values averaged over three peanut genotypes) (bars topped with different letters were significantly different (0.05) according to Newman-Keuls mean separation procedure).

negative correlation was found on Florunner leaves emerging 86 DAP (correlation coefficient -0.647, P = 0.022).

Yield. Yield in Florunner was increased by fungicide applications more so than in Southern Runner and UF 81206 (Table 19), which resulted in significant fungicide schedule x genotype interactions at all digging dates. There were no significant yield increases attributable to fungicide applications at any of the digging dates in UF 81206.

Trends similar to those in the yield analyses were seen in the analyses of yield loss in the form of dropped pods (Table 19). Significant differences between means of the nonsprayed and 20-day and 10-day schedule, and between each of the three fungicide schedules on Florunner were found at the first and second digging dates, respectively. No significant decreases in pod drop occurred in Southern Runner or UF 81206 in response to fungicide schedule.

The peanut profile method of maturity determination (112) using pods sampled in the 20-day schedule fungicide schedule treatment indicated the first digging date (125 DAP) was optimal for Florunner while the second digging date (139 DAP) was found to be optimal for Southern Runner and UF 81206. No pod maturity test was conducted for the 160 DAP digging date which gave the highest yield for Southern Runner and UF 81206.

Table 19. Effect of fungicide application schedule on yield and weight of dropped pods for each of three peanut genotypes when plants were dug on three different dates.

		Digging date				
		125 DAP[x]		139 DAP		160 DAP
Genotype	Fungicide spray interval[y]	Yield (kg/ha)	Dropped pods (kg/ha)	Yield (kg/ha)	Dropped pods (kg/ha)	Yield (kg/ha)
Florunner	Nonsprayed	2868 C[z]	1152 A	1228 C	4694 A	636 B
	19 day	5105 B	440 B	3322 B	3195 B	1429 B
	9-day	5791 A	367 B	5623 A	1039 C	3579 A
Southern Runner	Nonsprayed	3676 B	213 A	4133 B	243 A	4261 B
	19-day	4298 A	179 A	4957 A	173 A	5404 A
	9-day	4276 AB	371 A	4937 A	375 A	5801 A
UF 81206	Nonsprayed	3834 A	106 A	4596 A	127 A	4591 A
	19-day	4011 A	164 A	4840 A	65 A	5425 A
	9-day	3890 A	119 A	4667 A	207 A	5562 A

x - Days after planting.

y - Nonsprayed plots received no applications of fungicide for the control of peanut leafspot. 9- and 19-day plots received applications of chlorothalonil (2.48 l/ha) on a 9- or 19-day schedule, respectively.

z- Means within a genotype followed by different letters are significantly different [illegible] according to the Newman-Keuls mean separation procedure.

Interaction Test (II)

Disease. Greater amounts of early leafspot were found in Southern Runner than in UF 81206 at each assessment date (Table 20). With analyses of variance of early leafspot severity (ELS), border row x genotype interactions were found to be significant (86 and 100 DAP, Table 20) because a significant increase of ELS occurred in Southern Runner plots bordered by nonsprayed Florunner that did not occur in UF 81206. Where no significant interaction occurred, nonsprayed Florunner borders resulted in higher ELS levels in both genotypes.

Although statistically significant differences in the ELS were found between genotypes and border row treatments, the highest mean for ELS within any treatment where significant differences were found was 2.6. At the majority of assessment dates, early leafspot was not the predominant of the two leafspot diseases.

Southern Runner usually had significantly higher LLS than UF 81206 (Table 21). At 86 DAP a significant border row x genotype interaction was found in analyses of variance of LLS (middle and top canopy, Table 22). As was found with ELS, this interaction resulted from a significant border row-influence on Southern Runner but not on UF 81206. Nonsprayed Florunner border rows resulted in higher amounts of LLS in both genotypes where no significant border row x genotype interaction occurred.

Since significant effects of both border row and genotype were demonstrated in analyses of variance of both ELS and LLS, disease progress analyses were performed with the sum of ELS and LLS (peanut leafspot severity, PLS).

Table 20. Effects of inoculum level from surrounding border rows and genotype on the severity of early leafspot. Data are shown for all assessment dates and canopy regions for which a significant genotype effect (without a significant genotype X border row interaction) was found by the analysis of variance.

		Early leafspot severity at intervals after planting					
	Border rows[y]	79 DAP[x]	86 DAP	100 DAP		114 DAP	123 DAP
Genotype		Bottom	Top	Middle	Top	Top	Top
Southern Runner	-----	0.74 a[z]	0.2 a	0.8 a	0.3 a	---	[illegible]
UF 81206	-----	0.31 b	0.02 b	0.[illegible] b	0.1 b	----	[illegible]
-----	Nonsprayed	0.75 a	0.14 a	0.71 a	0.4 a	0.3 a	[illegible]
	Sprayed	0.3 b	0.04 b	0.45 b	0.1 b	0.05 b	----

x - Days after planting.

y - Border rows were related to the degree of disease control effected in surrounding plots of Florunner peanuts as follows: nonsprayed plots were surrounded by unprotected plots of Florunner, sprayed plots were surrounded by Florunner plots which were sprayed with a protectant fungicide.

z - Means within a genotype - canopy region column followed by different letters are significantly different at the P = 0.05 level, according to the Newman-Keuls mean separation procedure.

Table 21. Effects of inoculum level from surrounding border rows and genotype on the severity of late leafspot. Data are shown for all assessment dates and canopy regions for which a significant genotype effect (without a significant genotype x border row interaction) was found in the analysis of variance.

		Late leafspot severity at intervals after planting								
		71 DAP[x]		79 DAP	86 DAP	100 DAP		114 DAP	123 DAP	136 DAP
Genotype	Border rows[y]	Middle	Top	Top	Bottom	Middle	Top	Top	Top	Top
Southern Runner	----	0.0002A[z]	0.001 A	0.005a	0.521A	3.6a	2.8A	3.2A	----	5.6A
UF 81206	----	0.0001B	0.0001B	0.001a	0.026B	1.6b	1.2B	2.3B	----	2.7B
----	Nonsprayed		0.001 A	0.005a		3.3a	3.4A	4.4A	4.1A	5.4A
	Sprayed		0.0001B	0.001b		1.8b	0.6B	1.1B	2.3B	3.0B

x - Days after planting.

y - Border rows were related to the degree of disease control effected in surrounding plots of Florunner peanuts as follows. nonsprayed plots were surrounded by unprotected plots of Florunner, sprayed plots were surrounded by Florunner plots which were sprayed with a protectant fungicide.

z - Means within a genotype - canopy region or border row - canopy region column followed by different letters are significantly different (P = 0.05), according to the Newman-Keuls mean separation procedure.

Table 22. Effects of inoculum level from surrounding border rows and genotype on the severity of early and late leafspot. Data are shown for all assessment dates and canopy regions for which a significant genotype X border row interaction was found in the analysis of variance.

		Disease severity 86 DAP[x]			
		Early leafspot		Late leafspot	
Genotype	Border rows[y]	Bottom	Middle	Middle	Top
Southern Runner	Nonsprayed	2.6 a[z]	1.1 a	1.15A	0.34 A
	Sprayed	1.6 b	0.7 b	0.34B	0.10 B
UF 81206	Nonsprayed	0.3 a	0.2 a	0.02A	0.02 A
	Sprayed	0.9 a	0.2 a	0.01A	0.001A

---

x - Days after planting.

y - Border rows were related to the degree of disease control effected in surrounding plots of Florunner peanuts as follows: nonsprayed plots were surrounded by unsprayed plots of Florunner; sprayed plots were surrounded by Florunner plots which were sprayed with a protectant fungicide.

z - Means within a genotype - canopy region column followed by different letters are significantly different (P = 0.05), according to the Newman-Keuls mean separation procedure.

Levels of inoculum created by the nonsprayed and sprayed Florunner border rows did not significantly affect the rate of FLS progress within Southern Runner and UF 81206 (Tables 23 and 24). However, FLS was lower in both genotypes in the middle and top canopy regions when border rows were sprayed (Figures 43 through 45).

Defoliation. Defoliation was affected significantly by both genotype and inoculum level, and a significant interaction commonly occurred between these main effects. The amount of defoliation in Southern Runner bordered by nonsprayed Florunner was almost equivalent to that of the same treatment in UF 81206, but the defoliation in Southern Runner bordered by sprayed Florunner was greater than that found in the same treatment in UF 81206 (Table 25). For the first assessment date on which such a significant border row x genotype interaction was found (71 DAP, Table 26), the interaction resulted from a lack of a response in UF 81206 to inoculum level. When interactions between border row and genotype occurred in the top canopy region (114 and 123 DAP), the interaction was attributable to a lack of a significant increase in defoliation in Southern Runner plots bordered by nonsprayed Florunner. Significant differences between defoliation for Southern Runner and UF 81206 were found where significant interactions did not exist. Early in the season and in the bottom canopy region in particular, UF 81206 had greater amounts of defoliation than Southern Runner at 71, 79, and 86 DAP (Table 26). Defoliation means were 79.2% and 87.7% at 79 DAP in the bottom canopy for Southern Runner and UF 81206, respectively. Later in the season (100 and 136 DAP) the percentage of defoliation on Southern Runner was found to be significantly higher than that on UF 81206.

Table 23. Comparison of peanut leafspot epidemics in the genotypes Southern Runner and UF 81206 in bottom and middle canopy regions using simple linear regression techniques.

Canopy and genotype	Border^{y}	Regression of leafspot severity on time								
		Nontransformed^{x}			Logistic transformation^{x}			Gompertz transformation^{x}		
		Y_0	Slope	r^2	Y_0	Slope	r^2	Y_0	Slope	r^2
Bottom										
Southern Runner	Nonsprayed	-4.00	0.071a^{z}	0.584	-21.0	0.203a	0.872	-3.94	0.030a	0.864
	Sprayed	-3.26	0.056a	0.571	-19.7	0.168a	0.821	-3.69	0.025a	0.822
UF 81206	Nonsprayed	-0.43	0.008a	0.311	-17.4	0.129a	0.600	-3.20	0.016a	0.591
	Sprayed	-0.66	0.013a	0.255	-17.8	0.130a	0.586	-3.27	0.017a	0.558
Middle										
Southern Runner	Nonsprayed	-8.14	0.122a	0.630	-25.3	0.232a	0.885	-4.60	0.035a	0.896
	Sprayed	-5.40	0.080a	0.766	-24.0	0.199a	0.853	-4.28	0.029a	0.873
UF 81206	Nonsprayed	-6.64	0.095a	0.775	-22.1	0.167a	0.894	-4.13	0.026a	0.909
	Sprayed	-2.93	0.040b	0.657	-20.9	0.148a	0.884	-3.80	0.021b	0.91

x - Nontransformed data were the sum of early and late leafspot severities (PLS) in each canopy region, logit transformed data were ln((PLS / 100) / (1- (PLS / 100))), and Gompertz transformed data were (-ln(-ln(PLS / 100))).

y - Sprayed and nonsprayed borders were plots of Florunner peanuts treated with chlorothalonil (3.72 l/ha early in the season and 5 l/ha late in the season) on a 14 day interval and plots of F runner peanuts which received no fungicides for the control of peanut leafspot, respectively.

z - Regression slopes within each canopy layer/transformation group denoted by the same letter do no differ significantly at the P = 0.05 level.

Table 24. Comparison of peanut leafspot epidemics in the genotypes Southern Runner and UF 81206 in two canopy regions using simple linear regression techniques.

Genotype and Border^y	Regression of leafspot severities on time								
	Nontransformed^x			Logistic transformation^x			Gompertz transformation^x		
	Y_o	Slope	r^2	Y_o	Slope	r^2	Y_o	Slope	r^2
Southern Runner									
Nonsprayed	-7.85	0.108a^z	0.790	-17.4	0.119a	0.730	-3.67	0.021a	0.786
Sprayed	-5.70	0.072b	0.867	-20.6	0.140a	0.806	-3.92	0.022a	0.897
UF 81206									
Nonsprayed	-6.16	0.082a	0.804	-21.8	0.153a	0.808	4.10	0.024a	0.842
Sprayed	-2.43	0.030b	0.640	-23.4	0.152a	0.896	-4.01	0.020a	0.920

x - Nontransformed data were the sum of early and late leafspot severities (PLS) in each canopy region, logit transformed data were ln((PLS / 100) / (1- (PLS / 100))), and Gompertz transformed data were (-ln(-ln(PLS / 100))).

y - Sprayed and nonsprayed borders were plots of Florunner peanuts treated with chlorothalonil (3.72 l/ha early in the season and 5 l/ha late in the season) on a 14-day interval and plots of Florunner peanuts which received no fungicides for the control of peanut leafspot, respectively.

z - Regression slopes within each transformation group denoted by the same letter do not differ significantly at the P = 0.05 level.

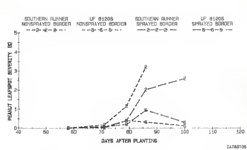


Figure 43. The progress of peanut leafspot on Southern Runner and UF 81206 in the bottom canopy subjected to two inoculum levels by using sprayed and nonsprayed border rows.

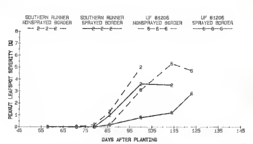


Figure 44. The progress of peanut leafspot on Southern Runner and UF 81206 in the middle canopy subjected to two inoculum levels by using nonsprayed and sprayed border rows.

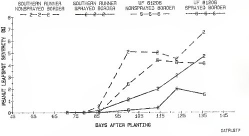


Figure 45. The progress of peanut leafspot on Southern Runner and UF 81206 in the top canopy subjected to two inoculum levels by using nonsprayed and sprayed border rows.

Table 25. Effect of inoculum level from surrounding border rows and genotype on defoliation.

		Percent defoliation			
				Both genotypes	
DAP[x]	Canopy region	Southern Runner	UF 81206	Nonsprayed[y]	Sprayed[y]
79	Overall	24.2 B[z]	32.4 A	----	----
86	Overall	28.6 b	30.9 a	31.0 a	28.5 b
	Bottom	95.0 a	91.0 b	----	----
	Middle	----	----	16.1 a	8.8 b
100	Overall	56.7 A	43.6 B	60.3 A	40.0 B
	Top	12.0 a	2.9 b	12.9 A	2.0 B
136	Overall	83.8 A	79.0 B	82.9 a	80.0 b
	Top	64.0 A	50.6 B	----	----

x - Days after planting.

y - Inoculum levels were related to the degree of disease control effected in surrounding plots of Florunner peanuts as follows. nonsprayed plots were surrounded by unprotected plots of Florunner, sprayed plots were surrounded by plots of Florunner which were sprayed with a protectant fungicide. Combined inoculum level analyses included all data from the specified genotype - canopy region group on the assessment date.

z - Means within a cultigen-canopy region row followed by different letters are significantly different at the P = 0.05 level (lower case letters) or P = 0.01 level (upper case), according to the Newman-Keuls mean separation procedure.

Table 26. Effect of inoculum level from surrounding plots on defoliation for two peanut genotypes.

		Percent defoliation at two inoculum levels			
		Southern Runner[y]		UF 81206	
DAP[x]	Canopy region	Nonsprayed	Sprayed	Nonsprayed	Sprayed
71	Overall Bottom	21.5 A[z] 65.0 A	15.1 B 41.7 B	32.0 A 80.6 A	31.3 A 76.4 A
100	Middle	99.2 A	80.9 B	85.0 A	30.6 B
114	Overall Top	83.3 A 52.2 a	72.6 B 45.2 a	81.3 A 53.1 A	55.4 B 18.9 B
123	Overall Top	84.7 A 59.4 a	77.8 B 56.8 a	80.8 A 57.2 A	67.6 B 33.5 B

x - Days after planting.

y - Inoculum levels were related to the degree of disease control effected in surrounding plots of Florunner peanuts as follows: nonsprayed plots were surrounded by unprotected plots of Florunner, sprayed plots were surrounded by plots of Florunner which were sprayed with a protectant fungicide. Combined inoculum level analyses included all data from the specified genotype - canopy region group on the assessment date.

z - Means within a genotype-canopy region row followed by different letters are significantly different at the P = 0.05 level (lower case letters) or P = 0.01 level (upper case), according to the Newman-Keuls mean separation procedure.

Where analysis of variance showed significant effects of inoculum level on defoliation, plots bordered by nonsprayed Florunner had greater amounts of defoliation than plots bordered by sprayed Florunner (Table 25).

When correlations between LLS and defoliation were performed, there was no significant correlation ($P \leq 0.05$) between these two variables within Southern Runner for any assessment date or canopy region (Table 27). Significant correlations between LLS and defoliation were found in UF #1206 in the middle canopy region at 100 DAP, and in the top canopy region at 100, 114, and 123 DAP. No calculations of total disease incorporating defoliation and LLS were performed because of this lack of significant LLS-defoliation correlation in Southern Runner.

Yield. Yield of UF #1206 was not significantly higher than that of Southern Runner, but there was a significant difference between yields because of inoculum level treatments (Figure 46).

Table 27. Correlation between late leafspot severity and defoliation for two peanut genotypes for all canopy regions in which sufficient but not excessive amounts of defoliation had occurred on each of seven assessment dates.

DAP[w]	Canopy region	Genotype	
		Southern Runner	UF 81206
71	Bottom	-.281[x] (1.000)[y]	NT[z]
79	Bottom	-.178 (1.000)	.430 (.287)
86	Bottom	-.042 (1.000)	.491 (.216)
	Middle	.602 (.114)	.135 (1.000)
100	Middle	.300 (1.000)	.855 (.006)
	Top	.542 (.182)	.933 (<.001)
114	Top	.489 (.218)	.903 (.002)
123	Top	-.218 (1.000)	.872 (.004)
136	Top	.632 (.092)	.636 (.090)

w - Days after planting.

x - Correlation coefficient calculated using data from plots exposed to two inoculum levels.

y - Probability of a greater Student's t ratio, significant if ≤ 0.05.

z - Not tested because of absence of late leafspot in this canopy region.

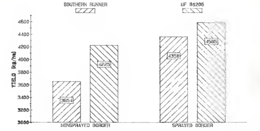


Figure 46. The yield of Southern Runner and UF 81206 at 140 DAP subjected to two inoculum levels.

Discussion

The levels of late leafspot resistance seen in the field in Southern Runner and UF 81206 have been shown in this study to be drastically greater than that of the most popular commercial cultivar in the Southeast (Florunner). Late leafspot was significantly less in Southern Runner and UF 81206 compared to Florunner. In fact, LLS in nonsprayed UF 81206 was nearly equivalent to that observed in Florunner plots receiving fungicide on a 10-day schedule. Reduction in late leafspot levels in the resistant genotypes is from the reduction of the rate of late leafspot progress in all canopy regions. Rates of late leafspot progress in Southern Runner and UF 81206 under an extreme level of inoculum in the interaction test (IT) experiment were still lower than those measured in nonsprayed Florunner plots in the FEPE. Clearly, resistance in Southern Runner and UF 81206 could be called "slow-leafspotting" after the designations of resistance that slow the rate of rust and powdery mildew epidemics in small grains (53, 55, 86).

Reductions in the rate of late leafspot progress in Southern Runner and UF 81206 were demonstrated with regressions using nontransformed data and data transformed with the logistic and Gompertz transformations. Although both transformations improved the fit of the model, the Gompertz transformation linearized the late leafspot progress curves better than the logistic transformation. Because of the better fit of the Gompertz transformed data, more significant differences were detected between rates of LLS increase and treatments.

The high degree of resistance in Southern Runner and UF 81206 was seen even when the genotypes were exposed to high levels of inoculum in the IT. Peanut leafspot severity was held to less than 7% in Southern Runner and less than 5% in UF 81206 in all canopy regions in the IT. At the end of the growing season, nonsprayed Florunner, bordering the late leafspot resistant genotypes, was completely defoliated by late leafspot. Further, there was no consistent significant increase in the rate of late leafspot progress because of proximity to a border of nonsprayed Florunner in either Southern Runner or UF 81206, showing that the resistance in these genotypes still is effective where inoculum levels are high. Even though the rate of peanut leafspot increase was not significantly increased by nonsprayed borders of Florunner, early and late leafspot severities were increased by this treatment.

Fungicide applications did not significantly reduce LLS because of the resistance within Southern Runner and UF 81206. In contrast, each increase in fungicide applied to Florunner significantly reduced LLS. For this reason, fungicide schedule x genotype interactions occurred commonly in the analyses of variance involving LLS.

Reduction of the rate of disease progress by fungicide application was not significant for the late leafspot resistant genotypes except in the 10-day schedule treatments. Significant reductions in the rate of disease progress occurred in Florunner with each increment in fungicide application. A primary effect of fungicide application in the FEPE is the reduction in the rate of epidemic progress (6, 20, 106). However, Plaut and Berger (77) concluded that with late leafspot the primary effect of fungicide application was the reduction of initial disease.

Correction of LLS assessments for host growth (48, 106) with leaf area measurements is unnecessary since the leaf area in each canopy region for each genotype had already begun to decrease before disease onset (114). After disease onset in the majority of treatments, leaf area either stabilized or continued to decrease for the remainder of the season.

An increase in the number of nodes on the main stem (center stem) between consecutive assessment dates followed a similar pattern on all genotypes. Node accumulation over time as measured in this experiment disagrees with the data of Pixley (76), where main stem and lateral stem nodes were counted. Pixley (76) reported that Southern Runner and UF 81206 remained vegetative (producing nodes) while Florunner had a more determinate growth habit, ceasing to produce new nodes toward the end of the growing season. One reason for this difference may be that irrigation was applied regularly in the previous study while in our experiments (PREC in 1984 and 1985 and IT) irrigation was used sparingly or was not available. Water stress was not evident in any of these experiments but at no time did our node counts on the genotypes used in both studies exceed those made by Pixley (76).

The rate of accumulation of DLA (diseased leaf area) was significantly decreased in Southern Runner and UF 81206 compared with Florunner in the bottom and middle canopy regions. However, in the top canopy the rate of DLA accumulation was greater in Southern Runner and UF 81206 than that in Florunner, but not significantly so. Interplot interference was probably a factor that increased the rate of accumulation of DLA in the [illegible] particularly, if one or more of the components of resistance ([illegible], 11) in either Southern Runner or UF 81206 affects the amount of sporulation and not lesion formation in the resistant genotypes. Another possibility for this difference between canopy regions is that there may be a difference between the genotypes in the ability of the canopy to "catch" spores (109). Certainly, if the interception of inoculum of *C. personatus* is proportional to the amount of the leaf area of the crop, then the inoculum interception within Southern Runner and UF 81206 would be greater than that of Florunner, because the two resistant genotypes have greater LAI values in the top canopy than Florunner. If there is indeed an increased spore catch in Southern Runner and UF 81206, we would expect this to be more important if the reduction of the number of lesions formed from such inoculum is not a component of resistance inherent in these genotypes.

Although rates of DLA accumulation in the top canopy region of Southern Runner and UF 81206 were not decreased by late leafspot resistance, the amounts of DLA at each assessment date in these genotypes was less than that of Florunner. Amounts of DLA were decreased in these resistant genotypes to a point where fungicide applications did not significantly reduce DLA further. In contrast, fungicide sprays resulted in significant decreases in DLA in Florunner. Thus, several significant fungicide schedule x genotype interactions occurred within analyses of variance involving this variable. Even though LAI within the canopy regions of the late leafspot resistant genotypes were greater than those found in

Florunner, the amount of diseased tissue was significantly lower in Southern Runner and UF 81206.

Defoliation associated with peanut leafspot could be a determining factor in the amount of yield loss induced by the diseases (95). In the PBPE, Southern Runner and UF 81206 had large amounts of defoliation occurring in canopy regions where low amounts of LLS were observed. For example, when amounts of LLS in each of the three genotypes was 1% in a canopy region where a significant correlation between late leafspot severity and defoliation was found, defoliation for Florunner, Southern Runner, and UF 81206 ranged from 1.4-7.2%, 13.2-28.8%, and 6.8-58.8%, respectively. Mean defoliation for Florunner, Southern Runner, and UF 81206 when LLS equaled 1% was 3.6%, 21.6%, and 34.8%, respectively. These data could be construed to mean that more defoliation occurs at lower leafspot severities in Southern Runner and UF 81206 than in Florunner. However, Southern Runner and UF 81206 had greater amounts of defoliation than did Florunner in the 20-day and 10-day fungicide schedules where disease control occurred, indicating that factors other than LLS induced defoliation in these genotypes.

In the bottom portion of the canopy, where late leafspot epidemics began and often are most severe (77), a significant positive correlation occurred between LLS and defoliation on Southern Runner on only two out of six assessment dates. At no time was there a significant LLS-defoliation correlation in the bottom canopy of UF 81206. In contrast, defoliation within Florunner was positively and significantly correlated to LLS in the bottom canopy on four of six assessment dates. In the middle and top canopy regions this correlation was significant with greater frequency on all three genotypes, being significant two of four times for Florunner and three of four times for Southern Runner and UF 81206 in the middle, and significant three of three times tested for all genotypes in the top canopy. Because of the higher leaf areas present in the top canopy of the resistant genotypes, the interception of conidia of *C. personatum* may have been increased in Southern Runner and UF 81206 in this canopy region. This interplot interference could have affected the analysis of LLS and defoliation correlations within these genotypes.

Leaf area evaluations gave a better indication of the health of a canopy region than did defoliation assessments. Defoliation assessments were not as accurate as the LAI measurements as they related only to the main stem while LAI values took into account all leaves and nodes within a canopy region. Secondary (lateral) branch production was greater on Southern Runner and UF 81206 compared with Florunner, as noted by Pixley (76).

The leaf area of Southern Runner and UF 81206 was not significantly limited by late leafspot. The strong, negative relationship between LLS and LAI that was expected did not occur within these genotypes. This, in turn, prohibits the use of defoliation to assess the effect of late leafspot on yield (93). Significant negative correlations did occur between LLS and LAI late in the epidemic in susceptible Florunner.

The lack of reliable defoliation assessments to estimate accurately the amounts of leaf area loss because of late leafspot prohibits the combination of LLS and defoliation into the variable total disease (77). Combination of LLS and defoliation assessments assumes a consistent, positive, and statistically significant relationship between the two variables, a trend not seen in this study.

With genotypes similar to Southern Runner and UF 81206, defoliation assessments should not be used to determine susceptibility or resistance to late leafspot. Factors other than LLS contribute to leaf abscission in Southern Runner and UF 81206. When screening genotypes for resistance to late leafspot, efforts should include measuring the amount of healthy leaf area present throughout the growing season. This approach was successful in the selection of Southern Runner and UF 81206 (D. W. Gorbet, personal communication).

Defoliation assessments did not relate well to yield in Southern Runner and UF 81206, but did in Florunner. Increases in top canopy defoliation by 52.5 and 45.9% did not significantly decrease yield in the resistant genotypes. In contrast, increases of top canopy defoliation at 135 DAP of 32.1 and 42.1% resulted in significantly lower yields in Florunner.

Southern Runner and UF 81206 maintained higher middle, top, and total canopy LAI than Florunner because of longer leaf retention and greater productive of foliage on secondary branches. Significant differences in LAI between Southern runner and UF 81206 and Florunner occurred late in the growing season when main stem node enumerations showed similar growth rates for all the genotypes. Fungicide applications extended individual leaf life and resulted in larger amounts of leaf area in the 20- and 10-day spray schedule treatments. Leaf area of all genotypes increased with fungicide applications, particularly with the 10-day spray schedule treatment.

Regardless of LLS, the most dramatic decreases in LAI in all genotypes and fungicide schedules occurred between the 70 and 87 DAP assessment dates, coincident with the onset of pod development. This trend was similar to that reported by McCloud (56). After 87 DAP, LAI in Florunner continued to decrease, while in Southern Runner and UF 81206 LAI remained at the same level throughout the remainder of the growing season. The resistant genotypes maintained a LAI greater than 3.0 after 87 DAP, which is the minimum LAI value necessary for maximum light interception (10).

Individual leaves emerging on Southern Runner and UF 81206 had less FLS than Florunner. As in the analyses of variance of LLS, significant interactions occurred because fungicide applications did not significantly reduce MAXDIS in Southern Runner and UF 81206, as they did in Florunner. The genotype effect in the statistical analyses was significant more frequently than the effect from fungicide schedule. Implications of this result are that the resistance of Southern Runner and UF 81206 had more of an effect on reduction of peanut leafspot on individual leaves than did fungicide applications.

Leaves of the resistant genotypes abscised in response to stimuli other than FLS. Correlations between MAXDIS and XMAX were significant only on Florunner leaves emerging 86 DAP, a surprising result since the greatest FLS assessed on individual leaves usually occurred just prior to abscision. Factors other than FLS that cause leaf abscision within Southern Runner and UF 81206 need to be elucidated.

Interpretation of the individual leaf assessment data would have been improved by denoting the canopy region to which the tagged leaf belonged. From the date of emergence we can only infer in which canopy region a particular set of tagged leaves were found.

The rate of reproductive biomass accumulation within Florunner is greater than that measured in Southern Runner and UF 81206, and pod weights were consistently higher in Florunner than in the resistant genotypes. A larger portion of the total biomass goes to pod weight in Florunner than in Southern Runner and UF 81206. Therefore, Florunner should have a higher yield potential at early digging dates, particularly if late leafspot is adequately controlled. However, since the LAI of Southern Runner and UF 81206 remains larger than Florunner for longer periods of time, regardless of fungicide application schedules, yield potential of these genotypes could reach that of Florunner. In these studies, reproductive biomass levels and harvest index were determined by the genotypes' genetic constitution and not by fungicide applications. No significant fungicide schedule effect was found in analyses of variance of either MAXDIS or XMAX.

The optimum harvest dates for Southern Runner and UF 81206 were found to be later than those for Florunner. In Southern Runner and UF 81206 each delay in digging date gave an increase in the yield regardless of the fungicide schedule. In fact, the maximum yield for any treatment in the PEPE occurred at the 160 DAP (29 days after the last fungicide application) harvest date in the 10-day schedule treatment of Southern Runner. Further, the lack of yield response between the 10- and 20-day fungicide schedules on Southern Runner supports the possibility that commercial growers may need no more than five fungicide applications per season. The absence of a significant effect of fungicide schedule on yield of UF 81206 at any harvest date again shows the high degree of late leafspot resistance inherent in this genotype.

Yields of both Southern Runner and UF 81206 were reduced by higher inoculum levels in the IT, showing yield reduction in these resistant genotypes is possible under extreme levels of inoculum. However, levels of inoculum in the IT from the nonsprayed border treatment exceeded those expected to occur in nearly all commercial situations.

If we compare the genotypes at their respective optimum harvest dates, Florunner had the highest yield with a 10-day spray schedule, demonstrating that partitioning of higher amounts of available photosynthate to the pods will result in higher yields if late leafspot is stringently controlled with fungicide applications. However, the yields of 20-day spray schedule treated Southern Runner and UF 81206 were competitive with the yield of Florunner under the same conditions. In the nonsprayed treatment, yields of the resistant genotypes were far superior to that of Florunner. Even under the extreme inoculum pressure in the IT, nonsprayed Southern Runner and UF 81206 yields were more than the nonsprayed Florunner treatment in the PEPE (4409, 4006, and 2868 kg/ha for Southern Runner and UF 81206 in the IT, and Florunner in the PEPE, respectively). Overall, the trends in the yield data followed those seen in the late leafspot assessment data.

Yield loss to dropped pods (those left in the field after combining) was not a significant factor at any fungicide schedule with either Southern Runner or UF 81206, but it was a factor at the first two harvest dates with Florunner. Significantly higher amounts of dropped pods were found in the nonsprayed Florunner plots compared to Southern Runner and UF 81206. As in the yield data, trends in the dropped pod data closely follow those found in the late leafspot severity data.

The level of resistance in Southern Runner is sufficient to give peanut growers a high yielding, late leafspot resistant genotype that will require fewer fungicide applications in commercial production than cultivars currently available. If released, UF 81206 would do the same. However, these genotypes will pose new problems and opportunities for plant pathologists, as fungicide applications to improve yield on these late leafspot resistant genotypes may involve more complicated timing methods than those currently in use. It may be profitable and feasible to use a predictive system to time fungicide applications (5, 37, 94) or to use an eradicant fungicide in conjunction with these prediction systems.

There is a need for new methods to assess the health and size of the peanut canopy as accurate leaf area accumulation measurement is now very time consuming and would not be practical in routine experimentation. These genotypes may begin a new era in peanut production in the United States where an truly integrated approach to late leafspot management will be possible.

CHAPTER III
COMPONENTS ANALYSIS EXPERIMENTS

Introduction

Investigations into the reactions of plants that vary in their resistance to disease have been performed for decades within the science of plant pathology. Since van der Plank (106) proposed that there were two general types of resistance, researchers have studied horizontal or rate-reducing resistance utilizing component-analysis experiments (114). The expression of rate-reducing resistance could result from inhibition of disease development in any stage from initial contact of the infectious propagule and the host to the beginning of secondary cycles of inoculum production on previously infected plant tissues. A single component of resistance would be a difference in any one of the stages of disease development within the monocycle (114) between a resistant and a susceptible plant genotype.

Component analyses are used to identify the components of resistance within resistant genotypes and to measure the differences in disease development on diverse genotypes after inoculation with a pathogen. Such experiments have been done with genotypes of small grains which retard the rate of progress of rust or powdery mildew diseases (51, 53, 54, 84, 86). Parlevliet (73) has reviewed many examples of components of resistance in various pathosystems. Two of the major foliar diseases of peanut (_Arachidis_ _hypogaea_) are early and late leafspot caused by _Cercospora_ _arachidicola_ Hori and _Cercosporidium_ _personatum_ (Berk. & Curt.) Deighton, respectively. Components of resistance to both diseases in peanut genotypes have been investigated in the past (1, 64, 71, 81, 111), with much of the recent research emphasis on plant genotypes resistant to early leafspot. An understanding of the components of resistance present in a particular genotype is important in the management of that genotype in the field, and also in breeding programs for improvement of resistance to peanut leafspot. If different peanut genotypes are shown to have differing components of resistance, the different components could eventually be incorporated into one genotype. A combination of components of resistance should result in a more resistant plant genotype.

The University of Florida peanut breeding program has produced high-yielding peanut genotypes that have been shown to reduce significantly the rate of progress of late leafspot of peanut (76 and Section 1). Several studies were conducted to identify the components of resistance inherent in Southern Runner (UF 80202) and UF 81206. Disease development on these genotypes resistant to late leafspot was compared with that on Florunner. Results of preliminary investigations into the components of resistance within Southern Runner have been previously reported (70).

Materials and Methods

The three genotypes used in the experiments each consisted of three component lines of similar plant types selected from a population derived from one cross. For studies in which individual component lines of each genotype were examined, only two of the three component lines of Florunner were used because in previous work (34) no differences in susceptibility to peanut leafspot was found among the three lines. For Southern Runner and UF 81206, no such information was available and all three component lines of each were used. Also, since the selection method used to identify resistant genotypes in the University of Florida breeding program relied on field evaluations, all of the component lines of Southern Runner and UF 81206 were included in the components-analysis experiments.

Component Analysis Experiments

In these experiments, incubation period (the time from inoculation until lesions became visible), latent period (the time from inoculation until sporulation began), lesion number, and sporulation per leaf and per lesion were the components that were measured. Differences in the appearance of lesions on Florunner, Southern Runner, and UF 81206 were also examined.

Three seeds of individual component lines of Florunner, Southern Runner, and UF 81206 were planted in 1.9 L plastic pots containing an artificial soil mix (Metro-Mix 220, Grace Corp., Lexington, MA) to which was added 15 ml of peat-based *Rhizobium* inoculum and 0.63 ml of Temik (aldicarb, Union Carbide, Jacksonville, FL). A few pots of the late leafspot susceptible cultivar Early Bunch were planted on the same date as the other genotypes. The pots were watered daily and upon emergence, the plants were thinned to one per pot.

The fungal isolate used in these studies was originally collected in Marianna, FL from the leaves of field-grown plants of the genotype Florunner. Conidial inoculum was produced on greenhouse-grown plants (cv. Early Bunch), by artificially inoculating them 24 to 30 days prior to collection, and maintaining them in a mist chamber under conditions optimal for sporulation. Conidia were collected from these source plants within 24 hr of inoculation of test plants. Conidia were collected into test tubes containing 10 ml of sterile distilled water by use of a cyclone spore collector attached to a vacuum pump set at 2.54 cm of Hg pressure. The suspension was stored in a refrigerator until use. The conidial suspension was adjusted to 4400 conidia per ml for the first component-analysis experiment and 4500 and 450 conidia per ml for the repeat of the experiment. One drop of Triton X-100 per 500 ml of the conidial suspension was added to reduce surface tension of the water in the inoculum suspension. Inoculum was applied to the test plants with pressure from a Spra-Tool (Fisher Scientific Products, Pittsburgh, PA) which dispensed 1 ml of the suspension per second.

Selected leaves, the second and third leaf from the top of the mainstem, and one leaf from a side stem, were tagged and inoculated with a conidial suspension of C. personatum 40 days after planting. The selected leaves were sprayed for 1 sec with the suspension while they were held horizontal by taping the abaxial leaf surface to a support made from wooden plant stakes. Only the adaxial side of the selected leaves was sprayed with the conidial suspension. After inoculation of the target leaves, the remainder of each plant was misted with the conidial suspension while the selected leaves were shielded to prevent additional inoculum from reaching them. Plant surfaces were allowed to dry completely before the leaves were unfastened from the wooden stakes. Inoculated plants were moved into a mist chamber where a continuous leaf wetness period of 48 hours was maintained. Twelve hr leaf wetness periods were maintained from 6 pm to 6 am daily for the remainder of the experiment. Inoculum viability was checked for each experiment by plating a sample of the conidial suspension on water agar. The percentage of conidia which germinated on the agar was determined 48 hr after inoculation.

The range of temperatures recorded within the mist chamber in the first components-analysis experiment was 13 to 39C, with the mean minimum and maximum temperatures being 16 and 35C, respectively. The plants in the second experiment were inoculated in the same greenhouse mist chamber used in the first experiment. After 12 days, the mist chamber was moved outdoors because adequate temperature control was not possible in the available greenhouse.

After inoculation, plants were examined at two day intervals for the appearance of lesions. The number of lesions and the number of sporulating lesions on the tagged leaves were counted every 2 days until the leaves abscised. Only data from the tagged leaves were used in the analysis of lesion number. After the tagged leaves abscised, the percentage of the lesions on the remaining leaves which were sporulating (% LSP) was determined for each inoculated plant. The occurrence of sporulation on individual lesions was assessed under a dissecting scope at 10 or 20 X magnification and was scored as positive when tufts of conidiophores (stromata) were present. The % LSP data were regressed against days after inoculation (DAI) to calculate the time when 50% of the lesions formed were sporulating (LP_{50})(75). The LP_{50} is the mean latent period.

For determination of the number of spores per lesion, spore collections were made using a cyclone spore collector as described previously after at least one genotype had reached its LP_{50}. Conidia from individual leaves were collected into test tubes containing 5 ml of a 1% copper sulfate solution and stored in the refrigator. Number of conidia in each of the collected samples was determined by counting all of the conidia in 0.1 ml of the suspension under the microscope and multiplying this number by 50 (5 ml total sample). On the day that spores were collected, the number of sporulating lesions on each sampled leaf was determined. These data were used to calculate the total number of conidia/leaf and the mean number of conidia/lesion.

Viability of conidia from late leafspot lesions on Florunner, Southern Runner, and UF 81206 was determined on 40 DAI. Conidia were collected from individual leaves into test tubes containing 2.5 ml of sterile distilled water. A 0.1 ml sample was removed from each tube and spread uniformly onto water agar in a petri dish. After removing this 0.1 ml sample, 2.6 ml of a 2% copper sulfate solution was added to the test tube. The test tubes were stored in a refrigerator until conidia could be counted. The dishes of water agar were placed in the mist chamber in the greenhouse for 48 hr and the percentage of conidia which had germinated was determined by counting those visible on a 15 mm diameter disk of agar removed from each plate. The conidia and germ tubes were stained with [illegible] before microscopic examination.

Variables of interest were subjected to analysis of variance using a completely random design (CRD) with four replications in the statistical analysis.

Fungicide Wash-off Experiment (FWO)

An experiment similar to the component-analysis experiment described above was conducted in the field at the North Florida Research and Education Center (NFREC) in Quincy. This test was isolated from commercial and experimental peanut plantings. Component lines of Florunner, Southern Runner, and UF 81206 were planted by hand in plots consisting of four rows, 0.91 m apart and 0.3 m in length. A randomized complete block design with four replications was used in the experimental layout and a mixture of Southern Runner and UF 81206 was planted around the experiment as a border. Standard herbicide and *Rhizobium* inoculant practices were followed. The fungicide Mancozeb 200 (mancozeb) was applied at double the labeled rate (4.5 kg/ha) on a 14-day interval beginning 20 DAP with a backpack sprayer using three hollow cone nozzles (D2-25) per row, and 3.5 kg/cm^2 of pressure with CO$_2$ as the propellant. The last application of the fungicide was made 14 days before planned inoculations with *C. personatum*.

The fifth, sixth, and seventh leaves from the top leaf on the mainstem of the center plant in the second and third rows in each plot were tagged with bell wire at 72 DAP. Just prior to inoculation, all tagged leaves were vigorously rinsed with water from a garden hose. Tagged leaves in the third row of each plot were not inoculated and were used as an indicator of the amount of late leafspot attributable to sources other than artificial inoculation. The leaves in the second row were inoculated 73 DAP with a suspension containing 4400 conidia of C. personatum per ml. Conidia used in the inoculation were obtained from diseased leaves of Florunner harvested from the field. Leaves were selected carefully and did not display any early leafspot symptoms. They were brought to the laboratory and incubated in petri dishes on moist filter paper under continuous light for 10 days. Conidia were collected by rinsing the adaxial surfaces of the incubated Florunner leaves with water from a wash bottle. At the time of inoculation of the experiment no early or late leafspot symptoms were observed in any of the genotypes. Tagged leaves of all three genotypes and their component lines were evaluated every three days to ascertain the date of first lesion development, number of lesions formed, coloration and general appearance of lesions, and the amount of sporulation.

Exposure Experiments

In 1984, component lines of Florunner, Southern Runner, and UF 81206 were planted in the greenhouse as described in the component-analysis experiments. Four different planting dates were used to establish four different age groups of the genotype component lines. Two weeks separated successive planting dates, and the plants were kept in the greenhouse, isolated from sources of peanut leafspot inoculum until the planned exposure. Plants of all four age groups were exposed to peanut leafspot inoculum on July 23, 1984 by placing them for 72 hr in border rows of Florunner to which no fungicide had been applied to control peanut leafspot. The four groups of plants had been planted 59, 44, 30, and 17 days prior to the exposure. This experiment was repeated, with the plants being placed in the field for 24 hr on September 7, 1984. There were no visible symptoms of peanut leafspot on the plants prior to their exposure to field inoculum in either test. After the exposure period the plants were brought back into the greenhouse for determination of the incubation period and the number of lesions formed on each plant. Plants were also rated for the severity of both early and late leafspot, with the latter being the predominant disease in the Florunner plots where the plants were exposed. The mean severities of early and late leafspot in the middle canopy of the Florunner plants at the first and second exposure dates were 0.001 and 0.1, and 0 and 7%, respectively.

Weather conditions during the first exposure period were excellent for the promotion of infections by C. arachidicola and C. personatum, with the maximum and minimum temperatures recorded within the 72 hr period being 32 and 21C, respectively. Rainfall occurred within each 24 hour cycle during this 72 hour period (0.6, 0.2, and 0.8 cm). On the second exposure date the weather was not as favorable for infection as there was no rainfall recorded and dry, windy conditions prevailed throughout the 24 hr period. The maximum and minimum temperatures within this 24 hr period were 23 and 15C, again not optimal for infection (optimal tempatures for infection between 23 and 26C).

A sample of leaflets from each plant age group showing visible symptoms of late leafspot was selected from two component lines of each genotype 24 days after the exposure period and placed on moistened filter paper in plastic petri dishes with the abaxial leaf surface facing up. Petri dishes were then sealed with Parafilm [illegible] Company, Greenwich, CT) and incubated at 2[illegible] under continuous light for 10 days. At this time conidia were vacuumed from the surface of each leaflet using previously described methods, and lesion diameters were measured. Measurement of lesion diameter was done under a dissecting scope at 10 X magnification, using a ruler marked with mm divisions. Since late leafspot lesions on these leaflets were generally circular, the formula for calculating the area of a circle was used to calculate the lesion area from which conidia were vacuumed.

Since plant age differed for each of the four groups of plants, severities of early and late leafspot were used to test for effect of plant age on susceptibility to infection. The number of lesions on the entire plant over all planting dates was used to compare the component lines of Florunner, Southern Runner, and UF 81206 for possible reductions in lesion number in the late leafspot-resistant genotypes.

In 1985 three groups of plants were exposed in the field as described above for a period of 24 hr. Each group of plants included the component lines of Florunner, Southern Runner, and UF 81206, and all plants were 35 days old at the time of exposure. Plants were exposed on July 17, August 22, and September 19, 1985. Data collected in these experiments were the mean number of lesions per leaflet on leaves on the mainstem.

Evaluations of Lesions on Leaves of Field-grown Plants

Leaves from Florunner, Southern Runner, and UF 81206 were removed from field plots which had received applications of chlorothalonil (Bravo 500, Fermenta Plant Protection Company, Cleveland, OH) as a

20-day interval. Leaves that were selected expressed late leafspot symptoms, with less than 10% of the leaf area affected. Leaves were collected on August 31, 1984 (120 days after planting), and on August 22 and September 20 in 1985 (100 and 129 days after planting). Individual leaflets from collected leaves were placed on moistened filter paper in plastic petri dishes with the abaxial leaf surface facing up. Petri dishes were then sealed with Parafilm and incubated at 25C under continuous light. After 10 days, lesions on 25 leaflets of Florunner, Southern Runner, and UF 81206 were assessed for the amount of sporulation. In 1984, lesion diameters were measured under the dissecting microscope and lesion area on each leaf calculated as described in the exposure experiment. Before the diameter of the lesion was measured, conidia were collected from them as described previously. In 1985, a relative rating scale modeled after that of Melouk and Banks (60) was used to assess the percentage of the area of each lesion supporting sporulation. The scale consisted of the following four classes: 0 = no sporulation, 1 = 1 to 25%, 2 = 26 to 50%, and 3 = > 50% of the lesion's area supporting sporulation. The percentage of lesions on the 25 leaflets falling into each class was calculated.

Size of lesions on each collection date was subjected to analysis of variance. In 1984, lesion diameter data were used as an indicator of lesion size. In 1985, leaflets were evaluated for sporulation, then placed in a plant press. The leaflet outline was traced with red ink onto clear transparency sheets and the lesions on that leaflet were traced in black ink. The leaflet outline with the lesion tracings was then run through a portable leaf area meter (Li-Cor Co., Lincoln, NE) and the mean area of the lesions on each leaflet was calculated by dividing the total lesion area per leaflet by the number of lesions per leaflet. Using this procedure, a measure of lesion size on field grown plants of each genotype was obtained.

Fluorescent Microscopy. Leaves from the second collection date in 1985 were evaluated with the use of a fluorescent microscope (52). After collecting leaves in the field, a sample of leaflets was placed in chloroform-methanol solution (2:1 v/v) for at least 5 days, with two to three changes of the chloroform-methanol solution to ensure removal of pigmentation from the leaflets. Leaflets were then transferred to a lactophenol-ethanol solution (1:2, v/v) for storage. This treatment resulted in removal of the pigmentation from the healthy leaf tissue, leaving the late leafspot lesions still visible as brown areas on the cleared leaflets. Leaves were prepared for viewing under the microscope by rinsing them in 50% ethanol, soaking them in water and then in 0.1 M Tris/HCL buffer (pH 7.4). Leaflets were left in each solution for 10 minutes. Lastly, leaflets were placed in a 0.1% Tinopal Tris/HCL solution (52) for 10 min. Each leaflet was rinsed in water, cut in half (along the midrib) and mounted in lactophenol on a glass slide, covered with a cover slip and viewed under the microscope. This technique allowed the clear observation of tufts of conidiophores on lesions via fluorescent microscopy.

The abaxial surface of twenty-five leaflets of each genotype were viewed under the fluorescent microscope. The number of lesions, lesions with conidiophore tufts, and conidiophore tufts were counted on each leaflet. When sufficient conidiophore tufts were present, the diameters of 10 of them were measured and, since they were circular, the mean area of each conidiophore tuft was calculated using the formula for the area of a circle. Diameters of the conidiophore tufts were measured at 160 X magnification with an ocular micrometer. The amount of sporulating area/leaflet was calculated by multiplying the mean area of a conidiophore tuft by the total number of conidiophore tufts on each leaflet. Sporulating area/sporulating lesion was calculated as the product of the mean area of a conidiophore tuft and the mean number of conidiophore tufts found on each sporulating lesion. This method provided a precise measurement of the potential sporulating area on leaflets of the three genotypes.

Results

In all experiments, no significant differences in the component lines of Florunner, Southern Runner, and UF 81206 occurred. There were some cases in which there were consistent but statistically nonsignificant differences within the component lines of Southern Runner and UF 81206. These trends will be pointed out in the appropriate following sections.

Germination on water agar of conidia used in the components analysis experiments was greater than 90% for both experiments. Use of conidia from lesions on live plants resulted in inoculum with a high degree of virulence.

Components Analysis Experiments

There were no differences among genotypes in the incubation period in either of these experiments; lesions began to appear 10 to 12 DAI all component lines of Florunner, Southern Runner, and UF 81206. Differences among genotypes in lesion color on the abaxial leaf surface were noted initially. The majority of lesions formed on UF 81206 were brown while those on Florunner were black (Table 28 and 29). Soon after lesions began to appear (12 to 16 DAI), the predominant lesion color on Southern Runner was brown as well. The brown lesions on Southern Runner and UF 81206 were typical of lesions resulting from infections of C. arachidicola, but at no time during these experiments were any plants exposed to inoculum of this pathogen. Over time, some brown lesions on all genotypes began to turn black (Tables 28 and 29) and, regardless of color, the lesions on Southern Runner and UF 81206 were smaller than those on Florunner. Early Bunch had larger lesions than Florunner but was not analyzed further.

Differences in the numbers of brown and black lesions on the three genotypes were statistically significant. However, no significant differences were observed among the component lines or genotypes for the number of total lesions (Table 28 and 29). However, there was a tendency for component line 2 of both Southern Runner and UF 81206 to have more lesions per leaflet than the other component lines within the respective genotypes.

Only the lesion counts for the low inoculum level (450 conidia/ml) are listed in Table 29. The data for the high inoculum level (4500) were similar. The higher inoculum level resulted in more rapid defoliation of the tagged leaves, with Southern Runner defoliating more rapidly than Florunner and UF 81206. The use of the lower

Table 28. Effect of component lines of three peanut genotypes on lesion number per leaflet in the first greenhouse component analysis experiment in which leaves were artificially inoculated with *Cercosporidium personatum*.

Genotype	Component line	Number of lesions of two color types									
		22 DAI[y]	25 DAI			26 DAI			28 DAI		
		Black	Brown	Black	Total	Brown	Black	Total	Brown	Black	Total
Florunner	CL - 1	27.1	6.9	34.8	41.7	12.0	34.1	46.0	8.4	49.5	57.9
	CL - 2	31.2	4.5	33.2	37.7	6.6	36.2	42.8	2.3	29.4	[illegible]
	Mean	29.2	5.7	34.0	39.7	9.3	35.2	44.4	5.4	[illegible]	[illegible]
Southern Runner	CL - 1	21.8	8.5	24.8	33.3	16.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	CL - 2	26.6	3.5	21.8	[illegible]	--	--	--	--	--	--
	CL - 3	28.3	--[z]	--	--	--	--	--	--	--	--
	Mean	25.6	6.0	33.3	[illegible]	16.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
UF 81206	CL - 1	2.5	28.5	4.5	33.0	20.8	0.3	21.1	13.2	7.7	20.9
	CL - 2	0.5	42.6	1.0	43.6	70.2	15.0	85.2	57.0	27.1	84.1
	CL - 3	1.7	75.7	5.3	80.9	53.6	5.6	59.3	42.0	10.9	52.9
	Mean	1.6	48.9	3.6	52.5	48.2	7.0	55.2	37.4	15.2	52.6

y - Days after inoculation.
z - No data collected because of defoliation.

Table 29. Effect of component lines of three peanut genotypes on lesion number per leaflet in the second greenhouse component analysis experiment in which leaves were artificially inoculated with *Cercosporidium [illegible]tum*.

Genotype	Component line	Number of lesions of two color types								
		21 DAI[a]			23 DAI			25 DAI		
		Brown	Black	Total	Brown	Black	Total	Brown	Black	Total
Florunner	CL - 1	3.8	4.4	8.2	2.9	8.2	11.1	2.8	9.0	11.8
	CL - 2	3.7	4.0	7.7	2.8	6.9	9.7	2.1	7.8	11.1
	Mean	3.8	4.2	8.0	2.9	7.6	10.4	2.5	8.4	11.3
Southern Runner	CL - 1	5.0	1.7	6.7	2.3	4.8	7.1	2.4	3.0	5.4
	CL - 2	3.6	5.6	9.3	2.2	7.8	10.0	1.5	8.2	9.6
	CL - 3	3.8	1.1	4.9	2.2	2.2	4.4	0.3	4.2	4.5
	Mean	4.1	2.8	7.0	2.2	4.9	7.2	1.4	5.1	6.5
UF 81206	CL - 1	9.6	0.03	9.6	7.7	1.4	9.2	9.1	1.2	10.3
	CL - 2	21.9	0.3	22.1	20.0	5.3	25.3	21.8	2.3	24.1
	CL - 3	6.5	0.0	6.5	6.4	1.1	7.5	7.2	0.8	8.0
	Mean	12.7	0.1	12.7	11.4	2.6	14.0	12.7	1.4	14.1

a - Days after inoculation.

inoculum concentration allowed for [illegible] of the resistance in the component lines of the genotypes.

Latent period (time from inoculation until 50% of lesions sporulating, LP_{50}) was longer on the late leafspot-resistant genotypes Southern Runner and UF 81206 than on Florunner (Figure 47). When nontransformed and probit transformed (R5) data were regressed against DAI, the LP_{50} for Florunner was found to be shorter than that for Southern Runner in both experiments (Tables 30, 31 and 32). The % LSP for component lines of UF 81206 never exceeded 10%, and sporulation was seldom observed on many of the lesions on this genotype. As a result, an LP_{50} value could not be determined for the component lines of UF 81206, even though the observations were carried on for more than 50 DAI.

In the second component-analysis experiment (Table 32), latent period in both Florunner and Southern Runner was lengthened with the lower inoculum concentration, but because of rapid defoliation at the high inoculum concentration, this comparison is nebulous. The LP_{50} values for Southern Runner in this experiment were longer than those found in the first component analysis experiment. The coefficient of determination (r^2) for Southern Runner for the regression of % LSP on DAI was lower in the second components analysis experiment, and this poor fit may have had an effect on the calculation of a longer LP_{50} in the second experiment than in the first.

Numbers of conidia collected from late leafspot lesions on each genotype after Florunner had reached its LP_{50}. Fewer spores were produced on Southern Runner and UF 81206 than on Florunner (component-analysis experiment #1, Figure 48 and 49). Even after the LP_{50} date

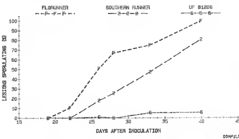


Figure 47. Changes in the percentage of late leafspot lesions sporulating on Florunner, Southern Runner, and UF 81206 in a greenhouse component-analysis experiment.

Table 30. Results of regression of the percentage of sporulating late leafspot lesions on number of days after inoculation (4400 conidia/ml) for the component lines of the peanut genotypes Florunner and Southern Runner. Results are from the first components analysis experiment.

		Calculated regression coefficients and predicted LP_{50}							
		Nontransformed				Probit transformation			
Genotype	Component line	Y_o[x]	Slope	r^2[y]	LP_{50}[z]	Y_o	Slope	r^2	LP_{50}
Florunner	CL - 1	-16.1	8.02	0.849	26.3	-3.46	0.31	0.821	26.9
	CL - 2	-68.9	4.29	0.728	27.7	-0.87	0.22	0.851	27.1
	Overall	-81.7	4.86	0.695	27.1	-1.42	0.24	0.824	27.2
Southern Runner	CL - 1	-107.0	4.82	0.824	32.7	0.33	0.14	0.814	32.5
	CL - 2	-84.8	4.27	0.665	31.5	0.17	0.16	0.613	31.0
	CL - 3	-94.4	4.20	0.851	34.4	0.71	0.12	0.828	34.3
	Overall	-95.2	4.43	0.741	32.8	0.39	0.14	0.682	32.4

x - Estimated intercept.
y - Coefficient of determination.
z - Number of days from inoculation until 50% of lesions sporulated, estimated from the regression equations.

Table 31. Results of regression of the percentage of sporulating late leafspot lesions on number of days after inoculation (4500 conidia/ml) for the component lines of the peanut genotypes Florunner and Southern Runner. Results are from the second components analysis experiment.

Genotype	Component line	Nontransformed Y_o[w]	Nontransformed Slope	Nontransformed r^2[x]	Nontransformed LP_{50}[y]	Probit transformation Y_o	Probit transformation Slope	Probit transformation r^2	[illegible]
Florunner	CL - 1	-303.0	15.2	0.887	23.2	-5.90	0.47	0.831	[illegible]
	CL - 2	-298.0	15.0	0.975	23.2	-4.86	0.43	0.971	[illegible]
	Overall	-300.0	15.1	0.914	23.2	-5.50	0.45	0.964	[illegible]
Southern Runner	CL - 1	----[z]	----	< 0.100	----	----	----	< 0.100	[illegible]
	CL - 2	- 85.0	3.60	0.819	37.5	-1.71	0.19	0.885	[illegible]
	CL - 3	----	----	< 0.100	----	----	----	< 0.100	[illegible]
	Overall	----	----	< 0.100	----	2.48	0.06	0.122	[illegible]

w - Estimated intercept.

x - Coefficient of determination.

y - Number of days from inoculation until 50% of lesions sporulated, estimated from the regression equations.

z - Not reported because of poor fit of the regression model.

Table 32. Results of regression of the percentage of sporulating late leafspot lesions on number of days after inoculation (450 conidia/ml) for the component lines of the peanut genotypes Florunner and Southern Runner. Results are from the second components analysis experiment.

		Calculated regression coefficients and predicted LP_{50}							
		Nontransformed				Probit transformation			
Genotype	Component line	Y_o^x	Slope	$r^{2\,y}$	$LP_{50}^{\,z}$	Y_o	Slope	r^2	LP_{50}
Florunner	GL - 1	-126.0	6.85	0.815	25.6	-1.76	0.27	[illegible]	[illegible]
	GL - 2	-119.0	6.65	0.858	25.5	-0.50	0.22	[illegible]	[illegible]
	Overall	-123.0	6.76	0.835	25.5	-1.03	[illegible]	[illegible]	[illegible]
Southern Runner	GL - 1	- 29.4	1.99	0.313	39.9	2.40	0.07	0.372	[illegible]
	GL - 2	- 34.5	2.05	0.362	41.3	2.30	0.07	0.312	[illegible]
	GL - 3	- 26.0	1.36	0.520	55.7	2.00	0.06	0.432	[illegible]
	Overall	- 26.4	1.59	0.313	45.1	2.51	0.06	0.277	[illegible]

x - Estimated intercept.
y - Coefficient of determination.
z - Number of days from inoculation until 50% of lesions sporulated, estimated from the regression equations.

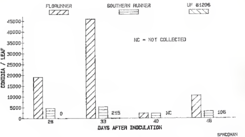


Figure 48. Changes in the number of conidia of Cercosporidium personatum per leaf on Florunner, Souther
Runner, and UF 81206 in a greenhouse component-analysis experiment (NC = not collected).

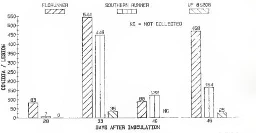


Figure 49. Changes in the number of conidia of *Cercosporidium personatum* per lesion on Florunner, Southern Runner, and UF 81206 in a greenhouse components-analysis experiment (NC = not collected).

was reached for Southern Runner there were fewer spores/lesion produced on this genotype than on Florunner. On only one collection date (40 DAI) was there more sporulation present on Southern Runner than Florunner, and the difference was slight (Figure 49). Because of the minimal sporulation on lesions on UF 81206, conidia were not vacuumed as frequently as on the other genotypes. Sporulation on UF 81206 was much less when compared to Southern Runner and Florunner.

No differences were observed in germination of conidia from lesions on Southern Runner and Florunner (40 DAI collection date). The mean germination percentage for conidia from lesions on Southern Runner component lines was 94.2%, while the germination for conidia from Florunner lesions was 91.3%.

Fungicide Wash-off Experiment (FWO)

Data from this field experiment agreed with those from component analysis experiments done in the greenhouse. There were differences in the lesion coloration on the abaxial leaf surface, again, with most lesions on UF 81206 being brown while those on Southern Runner and Florunner were generally black (Table 33). Also, as in the component analysis experiments in the greenhouse, lesions on Southern Runner and UF 81206 were smaller, regardless of their coloration on the abaxial leaf surface. One host reaction observed here, but not in greenhouse experiments, was the formation of lesions that were black in the center with a brown margin on the abaxial leaf surface. This unique lesion type was found frequently on Southern Runner component lines, and when these lesions were incubated to induce sporulation, the black portion of the lesion produced conidiophores. Conidia from these lesions were identified to be those of *C. personatus*. No lesions

Table 33. Effect of component lines of three peanut genotypes on lesion number in two field component and single experiments.

		Number of Lesions of Two Color Types[y]										
		Experiment 1										Experiment 2
		11 DAI[z]	12 DAI			14 DAI			17 DAI			21 DAI
Genotype	Component Line	Total	Brown	Black	Total	Brown	Black	Total	Brown	Black	Total	Total
Florunner	CL - 1	42.3	2.5	46.3	48.8	4.7	119.0	123.8	2.0	162.4	164.3	13.6
	CL - 2	32.3	2.8	37.3	40.0	2.7	100.3	103.0	2.7	107.3	176.8	13.6
	Mean	37.3	2.7	41.8	44.4	3.7	109.7	113.4	2.4	89.9	170.6	13.6
Southern Runner	CL - 1	38.3	6.3	33.4	39.8	24.7	85.7	110.0	62.6	28.5	92.8	6.5
	CL - 2	25.0	1.5	23.0	25.3	6.5	47.7	54.0	5.7	63.1	72.8	8.5
	CL - 3	31.8	7.0	20.0	27.8	26.3	47.3	75.8	44.0	41.1	87.0	6.3
	Mean	31.7	4.9	25.5	31.0	19.2	60.2	79.9	37.4	44.2	84.2	7.1
UF 81206	CL - 1	38.3	32.9	0.5	33.3	65.7	15.7	77.3	69.4	1.1	76.3	14.5
	CL - 2	25.0	38.6	8.4	46.8	96.3	2.3	98.5	99.7	0.0	99.5	17.2
	CL - 3	31.8	48.2	1.2	46.0	91.7	9.0	100.0	106.2	0.0	99.3	14.3
	Mean	31.7	39.9	3.4	42.0	84.6	9.0	91.9	91.8	0.4	89.7	15.3

y - Number of lesions per leaf in Experiment 1, number of lesions per leaflet in Experiment 2.
z - Days after inoculation.

were found on the tagged leaves in [illegible] left noninoculated, indicating that the late leafspot lesions on inoculated leaves resulted from artificial inoculation.

Significant effects for component line on the total number of lesions per leaf were identified by analysis of variance in data collected 11 and 17 DAI. No significant differences were noted among the genotype component line means (Newman-Keuls mean separation, p=0.05 level of significance). At all assessment dates in the 1984 FWO experiment, the total number of lesions/leaf resulting from inoculations was always higher on Florunner than on Southern Runner and UF 81206, although not significantly so. The collection of conidia from leaves in the FWO experiment showed similar trends as those identified in the component-analysis experiments (Figure 50).

Exposure Experiments

The total number of lesions per plant in any exposure experiment was not different for these genotypes (Tables 34 and 35). Since these plants were exposed to both early and late leafspot inoculum, it cannot be stated unequivocally that the brown lesion reaction on Southern Runner and UF 81206 was formed as a result of infection by late leafspot, particularly when equivalent numbers of brown lesions were found on Florunner 15 days after exposure (Table 34). However, in 1985 when exposed plants were all the same age (Table 35), brown lesions on the Southern Runner and UF 81206 component lines turned black with time. Mean percentages of brown lesions on Southern Runner and UF 81206 component lines at 12, 15, and 26 days after exposure were 52.2, 11.3, and 2.7%, and 81.4, 76.5 and 10.6%, respectively. A low percentage of brown lesions found on Florunner shows that the

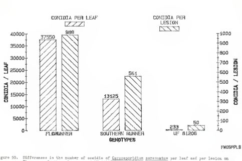


Figure 50. Differences in the number of conidia of Cercosporidium personatum per leaf and per lesion on Florunner, Southern Runner, and UF 81206 in a field components-analysis experiment.

Table 34. Effect of component lines of three peanut genotypes on lesion number in two experiments in which greenhouse grown plants were exposed to inoculum of *Cercosporidium personatum* by placing them in the field in [illegible].

		Number of lesions of two color types^w								
		Experiment 1^x			Experiment 2^y					
		15 DAE^z			21 DAE			24 DAE		
Genotype	Component line	Brown	Black	Total	Brown	Black	Total	Brown	Black	Total
Florunner	CL - 1	38	12	50						
	CL - 2	24	18	[illegible]						
	Mean	31	15	46	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Southern Runner	CL - 1	41	38	80						
	CL - 2	35	11	45						
	CL - 3	58	13	71						
	Mean	45	20	65	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
UF 81206	CL - 1	28	7	36						
	CL - 2	34	4	38						
	CL - 3	49	3	54						
	Mean	[illegible]	[illegible]	[illegible]	1.7	0.01	1.7	1.[illegible]	0.1	2.0

w - Number of lesions per plant in Experiment 1, number of lesions per leaf in Experiment 2, data are average of results for plants 17, 30, 44 and 59 days old at exposure.
x - Plants were exposed in the field for 72 h. and then returned to the greenhouse.
y - Plants were exposed in the field for 24 h. and then returned to the greenhouse.
z - Days after exposure in the field.

Table 35. Effect of component lines of three peanut genotypes on lesion number in an experiment in which greenhouse grown plants were exposed to inoculum of Cercosporidium personatum by placing them in the field for twenty-four hours. Exposure began on August 22, [illegible].

Cultigen	Component line	Number of lesions of two color types per leaflet^z								
		12 DAE			15 DAE			26 DAE		
		Brown	Black	Total	Brown	Black	Total	Brown	Black	Total
Florunner	CL - 1	0.4	16.5	16.9	0.2	57.7	57.9	0.0	37.8	37.8
	CL - 2	0.8	20.7	21.4	0.6	24.5	25.1	30.5	11.0	41.5
	Mean	0.6	18.6	19.2	0.4	41.1	41.5	15.3	24.4	39.7
Southern Runner	CL - 1	8.4	12.2	20.6	2.9	34.9	37.8	0.2	21.3	21.4
	CL - 2	21.5	7.0	28.5	8.5	52.3	60.8	1.2	44.4	45.6
	CL - 3	3.2	4.7	7.9	2.4	17.0	19.4	1.2	26.8	26.9
	Mean	11.0	7.9	19.0	4.6	34.7	39.3	0.9	30.8	[illegible]
UF 81206	CL - 1	7.3	8.3	15.6	17.9	21.2	39.1	6.5	28.0	[illegible]
	CL - 2	14.0	0.1	14.1	20.0	2.6	22.6	1.2	36.4	[illegible]
	CL - 3	11.1	0.2	11.3	30.5	1.5	32.0	[illegible]	[illegible]	[illegible]
	Mean	10.8	2.9	13.7	22.8	8.4	[illegible]	[illegible]	[illegible]	[illegible]

z - Days after exposure; all plants were 35 days old when exposed.

majority of the inoculum was *C. personatum* that reached these plants when exposed. There were no significant differences in the number of conidia/lesion or in number of conidia/mm^2 of lesion for the different component lines within a genotype when the lines were exposed to natural inoculum in the field.

Sporulation on a per lesion and per lesion area (mm^2) basis on Florunner was significantly higher than that on Southern Runner and UF 81206 (Figure 51). Only sporulating lesions were counted in the collection of these data.

Effects of plant age were not definitive. The youngest set of plants (17 DAP) were found to have significantly lower disease severities for all the genotype component lines for the first exposure date in 1984. In the second exposure experiment, the youngest plants of all genotypes had significantly higher disease severities when compared to the other age groups.

Evaluation of Leaves Collected from Field Plots

In counts of 150 suspensions of conidia from lesions on field-produced leaves, sporulation was higher on Florunner than Southern Runner and UF 81206 (Figure 52). Sporulation per lesion on UF 81206 was significantly lower than on the other two genotypes, but no significant genotype effect was found for the number of spores per lesion area.

Figures 53 and 54 illustrate relative differences in sporulation on the three genotypes with a sporulation scale. At 100 DAP, the majority of the lesions on Florunner were in class 2, with 66% of the lesions in classes 2 and 3 (Figure 53). Lesions on Southern Runner had less of their area supporting sporulation, as 52% of the lesions

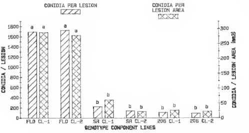


Figure 51. The number of conidia of Cercosporidium personatum per lesion and per lesion area from lesions on component lines of Florunner, Southern Runner, and UF 81206 24 days after exposure to late leafspot in the field in 1984 [bars topped with different letters are significantly different (0.05) according to Newman-Keuls mean separation procedure].

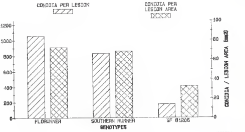


Figure 52. The number of conidia of *Cercosporidium personatum* per lesion and per lesion area from lesions on leaves of Florunner, Southern Runner, and UF 81206 collected from the field and incubated to induce sporulation.

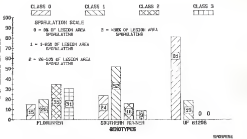


Figure 53. The percentage of lesion area of *Cercosporidium personatum* on three genotypes collected from the field (100 days after planting) supporting sporulation.

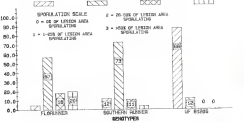


Figure 54. The percentage of lesion area of *Cercosporidium personatum* on three genotypes collected from the field (129 days after planting) supporting sporulation.

surveyed were in class 1 and 76% in classes 1 and 2. No lesion on UF 81206 was found to be in class 2 or 3, and the vast majority fell into class 0.

By 129 DAP, there was a decline in sporulation on Florunner lesions. Greater numbers of lesions on Southern Runner were in class 1 by this time, with a corresponding decline in the number of lesions in class 0 (Figure 54). No differences were noted in sporulation of lesions on UF 81206 between the first and second collection dates.

The size of lesions on Florunner was significantly greater than that of lesions on Southern Runner and UF 81206, and lesions on Southern Runner were significantly larger than those on UF 81206 (Figure 55). This was true regardless of the method used to measure lesion size. On the 1985 collection dates, lesions on all the genotypes increased in size between the first and second measurement dates.

Fluorescent microscopy. The genotype UF 81206 had significantly fewer lesions with conidiophore tufts (stromata) than Florunner and Southern Runner when viewed with fluorescent microscopy (Figure 56). This reduction in stromata follows a trend identified when individual late leafspot lesions were assigned to classes based on the area of the lesion supporting sporulation (86, 77, and 19% and 95, 88, and 12% of late leafspot lesions were sporulating on Florunner, Southern Runner, and UF 81206 at 100 and 129 DAP, respectively). Further, there was a significant decrease in the diameter of the conidiophore tufts on late leafspot lesions on Southern Runner when compared with Florunner. UF 81206 was not included in this statistical analysis because extremely low numbers of conidiophore tufts were found on the leaflets examined,

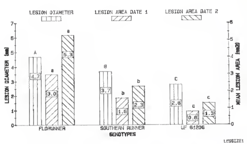


Figure 55. Lesion diameter and area of late leafspot lesions on leaves of Florunner, Southern Runner, and UF 81206 collected in the field (lesion diameter was measured in 1984 and lesion area in 1985 on leaves collected 120 days after planting (DAP), and 100 and 129 DAP, respectively)[within each variable, bars topped with different letters are significantly different (0.01 and 0.05 upper and lower case, respectively) according to Newman-Keuls mean separation procedure]

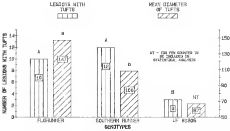


Figure 36. The number of lesions with conidiophore tufts (stromata) and the mean diameter of conidiophore tufts on late leafspot lesions on Florunner, Southern Runner, and UF 81206 measured by means of fluorescence microscopy [within each variable, bars topped with different letters are significantly different (0.01 and 0.05 upper and lower case, respectively) according to Newman-Keuls mean separation procedure](NT - too few counted to be included in statistical analysis).

but the mean diameter of the conidiophore tufts was found to be much less that measured on Florunner or Southern Runner.

The sporulating area per leaflet, per lesion, and per sporulating lesion was significantly less on Southern Runner and UF 81206 than on Florunner (Figure 57). The reduction in sporulation area follows trends first identified with sporulation counts done for component-analysis, FWO, and exposure experiments.

Discussion

In all field and greenhouse experiments there were no differences in the total number of lesions formed on Florunner, Southern Runner, and UF 81206. There was a difference, particularly for UF 81206, in the lesion coloration when these genotypes were inoculated with C. personatum. Since reduction in lesion number is not a component of resistance present in Southern Runner and UF 81206 it is reasonable to assume that the resistance in these genotypes begins to be manifested after penetration of the fungus into the plant. Therefore, the reduction of penetration sites through fewer stomata (13, 28) or an inhibition of spore germination on the leaf surface would not be expected to occur in Southern Runner and UF 81206 if compared to Florunner.

Leaves on the resistant genotypes abscised more rapidly than the leaves of Florunner. This tendency was greater at higher inoculum levels and greater in Southern Runner than in UF 81206. Reasons for this response merit further investigation, but large amounts of

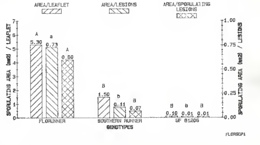


Figure 57. The amount of sporulating area per leaflet, lesion, and sporulating lesion on late leafspot lesions on leaflets of Florunner, Southern Runner, and UF 81206 harvested from the field [within each variable, bars topped with different letters are significantly different (0.01 and 0.05 upper and lower case, respectively) according to Newman-Keuls mean separation procedure].

defoliation in the late leafspot resistant genotypes were shown to have no significant effect on yield (Chapter II, PEPE).

The difference in lesion coloration will pose problems for field research with Southern Runner and UF 81206 particularly in areas where early leafspot is the predominant foliar disease. Lesions that may appear to be from infections of *C. arachidicola* may indeed be lesions from infections of *C. personatum*. There are no conclusive data available on the susceptibility or resistance of Southern Runner and UF 81206 to early leafspot. The inability to distinguish between the two diseases in the field may lead to false reports that the resistance in Southern Runner and UF 81206 may have been affected by an increase in the parasitic fitness of populations of *C. personatum* (26, 31, 32) that infect these genotypes. Such a report may in fact be the result of an epidemic of early leafspot taking advantage of a niche vacated by *C. personatum* due to the resistance to late leafspot in Southern Runner and UF 81206.

Since lesion number reduction is not a factor in the late leafspot resistance of Southern Runner and UF 81206, any crop management practice that reduces the amount of initial inoculum should enhance the performance of Southern Runner and UF 81206 in reducing subsequent late leafspot severity (6, 43). When these genotypes are not treated with a fungicide to control late leafspot, high levels of inoculum will increase the severity of late leafspot and decrease the yield of both Southern Runner and UF 81206 (Chapter II, IV).

Lesions of late leafspot on Southern Runner and UF 81206 were significantly smaller than those found on Florunner. Lesion areas were measured made on leaves collected in the field in 1985 at both the collection dates (100 and 129 DAP). It would take 21 more lesions on Southern Runner to equal the diseased area of ten late leafspot lesions on Florunner. This comparison is more impressive with UF 81206, as 40 late leafspot lesions on this genotype produce diseased area equal to that of only ten late leafspot lesions on Florunner. Late leafspot lesions increase in area later in the growing season on all three genotypes, but the differences in lesion size between Florunner and the other two genotypes increased between 100 and 129 DAP. The ratio of Florunner:Southern Runner lesion areas was 1.84 and 3.89 at 100 and 129 DAP, respectively. Florunner:UF 81206 lesion area ratios were 2.29 and 4.14 at 100 DAP and 129 DAP, respectively. The reduced size of late leafspot lesions on Southern Runner and UF 81206 decreases the late leafspot severity seen on these genotypes.

Along with a reduction of lesion size in Southern Runner and UF 81206, a lengthening of the latent period (LP_{50}) was also seen for these two genotypes when compared to Florunner. A lengthening of the latent period has been shown to be the most important factor in retarding disease progress in other plant-pathogen interactions (6, 74). The percentage of lesions sporulating on UF 81206 was too small to allow estimation or measurement of an LP_{50} value for this genotype. Using the assumptions that (i) a peanut crop would be harvested 140 DAP, (ii) that the first monocycle of a late leafspot epidemic in the field began 30 days after the planting of the peanut crop, (iii) that a monocycle (114) consisted of the number of days it took a cohort of lesions to reach a LP_{50} value, and (iv) that one used the lowest LP_{50} estimates for Florunner and Southern Runner found in the component analysis experiments, the maximum number of monocycles in Florunner would be 4.8. With the same assumptions, the maximum number of monocycles in Southern Runner would be 3.4, a reduction of 1.4 cycles when compared to Florunner. If we use the largest LP_{50} estimates found in the component analysis experiments for Florunner and Southern Runner with the same assumptions, the maximum number of monocycles for each genotype would be 4.0 and 2.4, respectively. It is clear that the lengthened latent period for Southern Runner and UF 81206 adds to the ability of these genotypes to slow the rate of progress of late leafspot epidemics.

Accompanying the delay in sporulation found in Southern Runner and UF 81206 was a reduction in the amount of sporulation on a per leaflet and per lesion basis compared to Florunner. When sporulation was followed over time, the amount of sporulation (conidia/lesion) in component lines of Southern Runner surpassed that of Florunner on only one of four collection dates. The cumulative number of spores produced on a per lesion basis on Florunner and Southern Runner was 1183 and 741, respectively (collected over a period of 16 days). Sporulation on late leafspot lesions on UF 81206 was reduced even more. The magnitude of the difference in sporulation between the late leafspot resistant genotypes and Florunner is such that, in field studies including these genotypes, autoinfection (114) in the Southern Runner and UF 81206 plots would probably be limited. Because of the possibility of larger amounts of alloinfection (cryptic error) (114) it is possible that the levels of late leafspot resistance seen in Southern Runner and UF 81206 in the field have been underestimated. When these genotypes are grown commercially in large fields away from other sources of inoculum, the number of fungicide applications needed to achieve acceptable control of late leafspot may be below that estimated from small plot experiments which include late leafspot susceptible cultivars such as Florunner.

Another useful method used to elucidate components of resistance was the evaluation of lesions through the use of fluorescent microscopy. Although no sectioning of leaf tissue was done in this study, the method used allowed distinction of fungal and plant tissues within the peanut leaf. Conidia of C. personatum and their germ tubes could be discerned on individual conidiophore tufts and the leaf surface. Another desirable aspect of this method is the ability to store leaves harvested from the field for long periods of time until a more convenient time for observation. This method is less time consuming than the counting of conidia vacuumed from lesions and the data derived using this method were more consistent than data from the other methods of assessing sporulation. The use of fluorescent microscopy along with the rating scale for the % of the area of the lesion supporting sporulation would be an accurate and powerful tool for the identification of genotypes of peanut that inhibit sporulation of C. personatum. The main drawback of fluorescent microscopy is the time required for viewing the lesions. In contrast, the rating scale has speed as one of its strong points. Because the use of the rating scale is not very time consuming, a researcher could use it to review a large number of genotypes or treatments. Also, since the rating scale concentrates on lower amounts of lesion area supporting sporulation, use of the ratings should identify plant types desirable for the enhancement of late leafspot resistance.

Throughout this study, intact plants were used, instead of detached leaflets as has been the case in other component-analysis experiments involving peanut leafspot (81, 111). The fact that more rapid leaf abscission occurs with Southern Runner and UF 81206 when they are infected with *C. personatum* precludes the effective use of a detached leaf technique to study these genotypes. Components analysis experiments conducted with slow-rusting oat genotypes and crown rust show that greenhouse and growth chamber environments alter the resistance seen in these genotypes in the field (54). A similar problem has occurred in the study of the components of resistance in peanuts, as Wells et. al (111) has demonstrated that detached leaflets perform differently than intact plants in the field. Reactions of Southern Runner and UF 81206 to *C. personatum* were consistent in both greehouse and field experiments, therefore, procedures utilized in all experiments were appropriate for study of the components of resistance in Southern Runner and UF 81206.

The resistance in Southern Runner and UF 81206 is manifested in effects on sporulation and in limiting the size of lesions resulting from infections by *C. personatum*. The resistance in these genotypes could perhaps be enhanced by hybridization with late leafspot resistant *Arachidis* genotypes that exert their main effect through the reduction of lesion number. However, even without further hybridization, availability of these genotypes to plant breeders and growers may begin a new era of research and production in peanuts in which the use of resistance will be a major disease management tool.

CHAPTER IV
SUMMARY

The resistance inherent in Southern Runner and UF 81206 was demonstrated to be rate-reducing in nautre due to the decreased lesion size, reduced sporulation, and a lengthened latent period. In assessing these components, no difference was found between tests done on intact plants grown in the field and in the greenhouse. Since reduced lesion numbers were not a component of resistance to late leafspot in either Southern Runner or UF 81206, the resistance in these genotypes should be enhanced by hybridization with genotypes found to reduce lesion numbers.

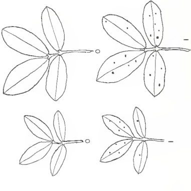
When conducting a screening program where components of resistance are used to differentiate peanut genotypes, more attention should be paid to early and late leafspot severity ratings (% of chlorosis and necrosis). Disease severity assessments would be the better assessment technique when evaluating populations similiar to Southern Runner and UF 81206 since these genotypes affect primarily lesion size and not lesion number. In the selection phase of a breeding program, it may be advantageous to assess disease severity in the top canopy region since this is the part of the crop that receives the majority of the solar radiation later in the growing season (10, 39).

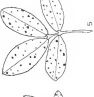
Assessment of the defoliation in populations of peanut genotypes similiar to Southern Runner and UF 81206 needs to be reevaluated as an indicator of resistance or susceptibility to peanut leafspot. There is some effect of peanut leafspot on defoliation but the lack of a significant correlation between late leafspot severity and leaf area index in Southern Runner and UF 81206 casts doubt that within these genotypes the primary instigator of defoliation is late leafspot. This relationship between late leafspot severity and defoliation merits further research but the research should be concentrated on the amount of healthy leaf area remaining in the plant canopy.

The main challenge for plant pathologists and peanut growers in working with Southern Runner and, perhaps eventually, UF 81206 will be the integration of disease and crop management techniques with the late leafspot resistance in these genotypes. Research on the most efficient use of fungicides to control late leafspot, the reaction of the genotypes to early leafspot, and methods to preserve the effectiveness of the late leafspot resistance in Southern Runner and UF 81206 once these genotypes reach the commercial situation should be top priorities. The release of high yielding and leafspot-resistant peanut genotypes may complicate the decision-making process of the peanut grower in the southeastern United States but this complication should also result in lower production costs and, perhaps, higher profits.

APPENDIX

STANDARD AREA DIAGRAMS USED IN ASSESSING EARLY AND LATE LEAFSPOT

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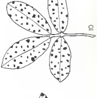
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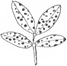

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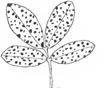

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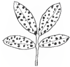

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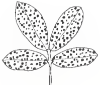

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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